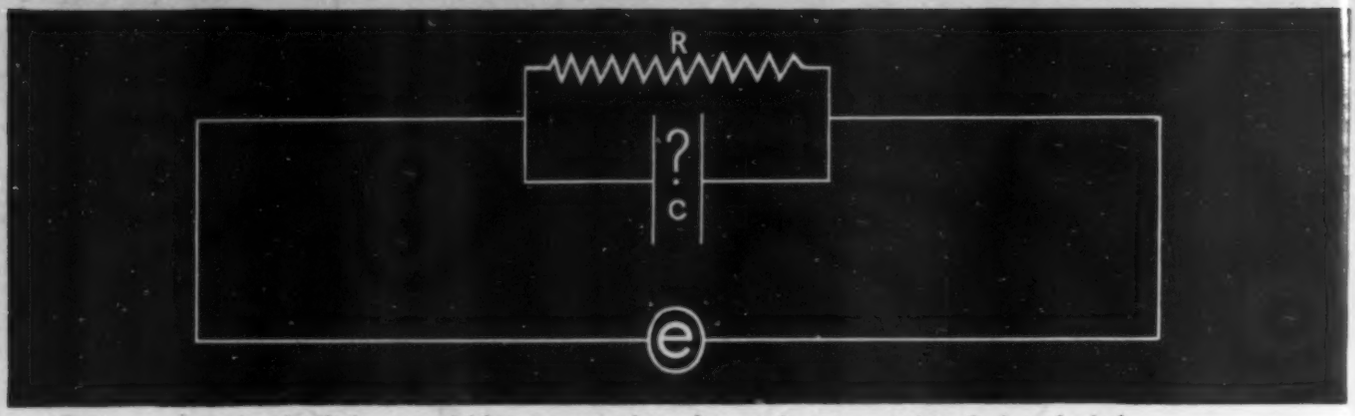
MODERN PLASTICS

JULY
1943

WHICH DUREZ PLASTIC WILL BEST MEET YOUR POWER FACTOR REQUIREMENTS?



Any insulating material between two electrodes constitutes a capacitor. Such a physical capacitor may be represented by a "pure" capacitance, C, and a resistance, R.

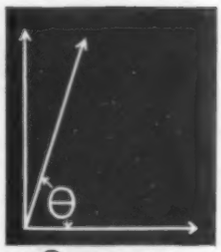
ALTHOUGH Durez molding compounds enjoy the reputation as being "tops" in insulating materials . . . few people realize the wide range in degree of insulation that they can furnish.

Since most plastic insulating materials deteriorate under heat, which is usually figured as power loss, Power Factor is customarily used as the measuring stick for the efficiency and lasting qualities of molding compounds.

To give yourself an idea of the Power Factor versatility of Durez plastics, read on the right what actually occurs when three different molding compounds are used in high frequency hook-ups. The theoretical explanation of the Power Factor figures is shown by the Vector diagrams which have been exaggerated purely for illustrative purposes.

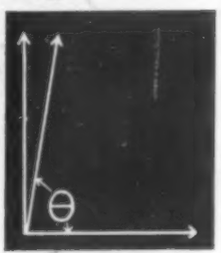
Of course, the Power Factor varies with the other requirements of the plastic. Durez technicians will be glad to recommend the material best suited to your over-all purposes. Just write to us, giving an outline of your specifications.

DUREZ 11540 is a general purpose molding compound with a Power Factor .05 and Dielectric Constant 5. It is excellent for direct current or low frequency applications such as light plugs and sockets, switch boxes, fuse boxes, etc. However, if this material were used in high frequency applications, you could practically "fry an egg" with the heat generated.



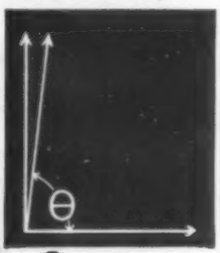
θ = 87° 8'

DUREZ 11863 is designed for most high frequency applications. Its Power Factor is .007 and Dielectric Constant 4.8. In fairly high frequency use, this molding compound has such a low power loss or low heat that it can be said to remain "cool as a cucumber" . . . giving corresponding greater efficiency.



θ = 89° 32'

DUREZ 1601 is especially formulated for use in still higher frequency applications. While it does not have the exact molding qualities of Durez 11863, it is particularly recommended for those "just over the line" applications where a Power Factor of .003 and Dielectric Constant of 4.8 do a better job. This material has the greatest efficiency in such applications and literally remains as "cold as ice."



θ = 89° 48'

DUREZ

PLASTICS THAT FIT THE JOB

DUREZ PLASTICS & CHEMICALS, INC., 227 WALCK ROAD, NORTH TONAWANDA, N. Y.

Transparency color

Probably no two physical characteristics have played more important roles in the original and increasing acceptance of Plastics than have the properties of transparency and color.

The acknowledged sales-appeal and design-potentials of color and the many decorative and practical applications for crystal-clear, tough materials helped write the history of the early years of this Plastic Age. When war replaced the automobile with the airplane and the luxury liner with the "PT" boat and submarine, lightweight colored and transparent plastic handles, knobs, signal dials, instrument panels, etc., brought the quick identification of controls so essential to fighters and war-workers.

Fabricators of "CATALIN", our cast phenolic resin, and molders of "LOALIN", our polystyrene compound, know them for their unlimited range of pure, gem-like colors and their brilliant transparency. No other plastic can match Catalin's depth and richness of color—not only in opaque and transparent forms, but in various degrees of translucency, as well. Its refractive index is 1.58-1.62...Loalin's is 1.59. Catalin's light transmission (in crystal-clear) is 80-90% . . . Loalin's is 88-90%. In addition, Loalin possesses the unique advantage of "bending" light around curves—of especial interest in current scientific applications and for industrial and home lighting in the immediate future.

Whatever else that future holds, we may be certain that the technical assets of the transparent plastics and the refreshing and stimulating properties of the color these miracle materials will bring into our everyday lives in homes, offices and factories, alike, will make important contributions to our fuller enjoyment of the fruits of Peace.

Cast Resins
Molding Compounds
Liquid Resins

CATALIN
CORPORATION

ONE PARK AVENUE • NEW YORK, N. Y.

ONE · OF · A · SERIES · ON · THE · PHYSICAL · PROPERTIES · OF · PLASTIC · MATERIALS

Modern Plastics
INCLUDING Plastics ENGINEERING

VOLUME 20 JULY 1943 NUMBER 11

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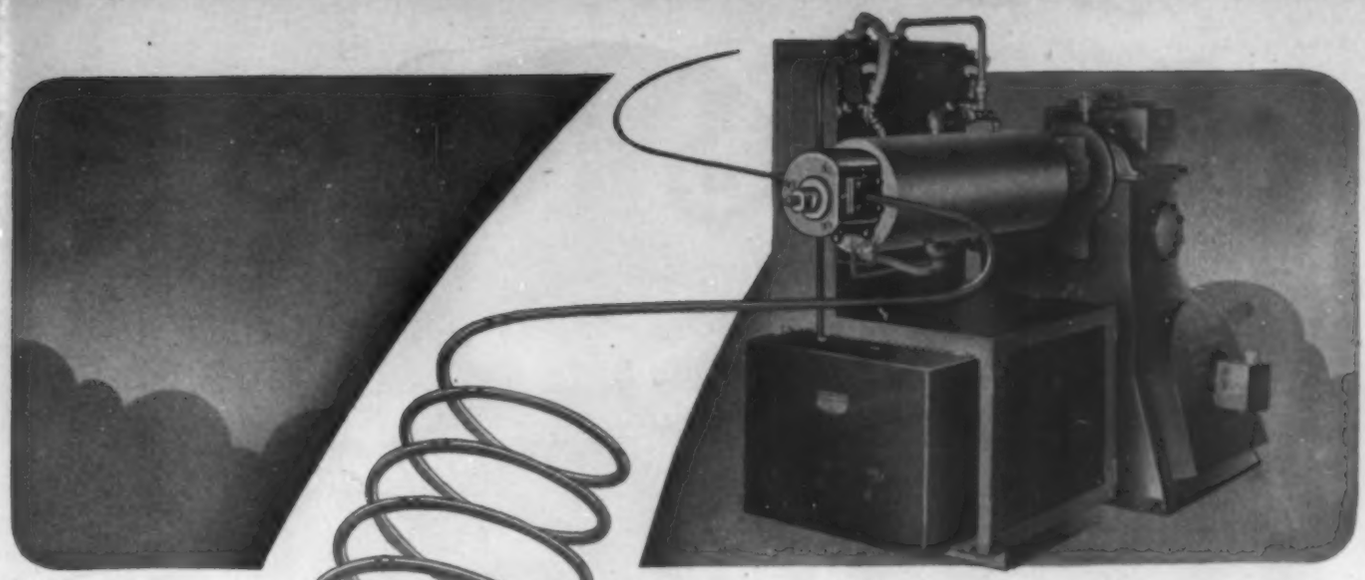


IT *Squirts* OUT CABLES FOR CRUISERS...

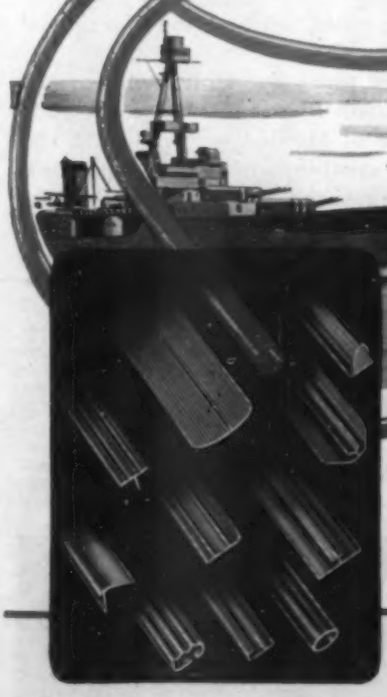
HUNDREDS of yards of insulated cable uncoil from this machine every hour—cable that is badly needed for every kind of warship, plane, tank and fighting vehicle. This particular plastic covering is one of the vinyl compounds. It makes a perfect insulator, releasing supplies of rubber urgently needed elsewhere.

Extruding Machine Keeps Cables Moving Fast

The machine is a National plastics extruder equipped with a crosshead developed by our engineers to fit the needs of this particular plastic. The design was worked out and tests run in National's own Pilot Plant. When the machine was turned over to the manufacturer, guesswork and headaches had been eliminated—the extruder could and did go *right* to work and has been producing continuously without a hitch.

How National's Engineering Service Can Help You

The extrusion process produces plastic forms of regular cross-section continuously, economically and with very little waste. Looking ahead, our engineers and chemists are working constantly with farsighted manufacturers, building machines for a specific plastic or a particular production job. This experience, which has helped us to produce more plastics extruders than all other makers combined, is available to you today—and may point the way to more efficient fabricating for your product.



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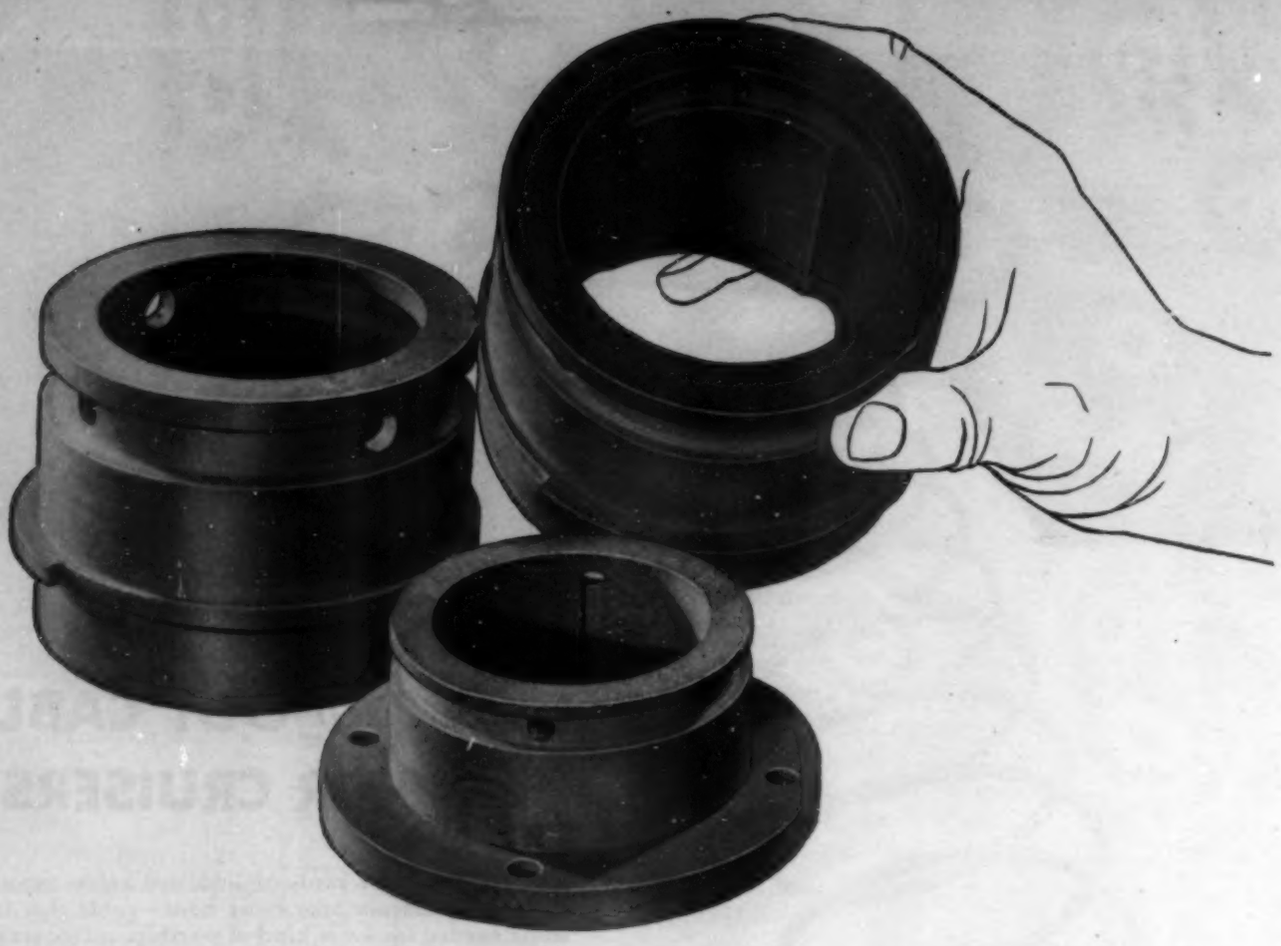
Plastics Division

NATIONAL RUBBER MACHINERY COMPANY

General Offices: Akron, Ohio



Salt water doesn't freeze
BEARINGS OF INSUROK

Cargo ships, escort vessels and submerging submarines, bound for the fighting fronts, face many hazards in addition to those of enemy craft. Pump bearings that have become frozen by electrolytic action, for instance, can cause dangerous delays and require costly, difficult repair.

That is one of the reasons why Laminated INSUROK is being used on many of the centrifugals that pump in ballast for submersion, that circulate water through important cooling systems, or that are just installed as stand-by equipment. In the development of this part, Richardson Plasticians suggested the grade of INSUROK best suited for this particular use—suggested it because of its high strength, wearability and dielectric qualities—recommended it because it has been so successfully used where self-lubricated as well as water, oil or grease lubricated bearings were required.

In meeting the needs of today and in helping to plan for "tomorrow," Richardson Plasticians are continually recommending the grade of Molded or Laminated INSUROK to meet various combinations of specifications. They will be glad to suggest the commercial or special grade to meet *all* the conditions under which your present or plan-stage product will perform. Write for complete information.

INSUROK

Precision Plastics

The RICHARDSON COMPANY

MELROSE PARK, ILL. · LOCKLAND, OHIO · FOUNDED 1858 · NEW BRUNSWICK, N. J. · INDIANAPOLIS, IND.
SALES OFFICES: 75 WEST ST., NEW YORK CITY; G. M. BUILDING, DETROIT

Why Du Pont "LUCITE" serves in all these battle planes...

AND MANY MORE

GLEAMING IN THE SUN, the Consolidated B-24 wings its way to battle with nose-piece, pilot's enclosure and top and tail turrets of Du Pont "Lucite." Practically unaffected by sun and weathering, "Lucite" retains transparency, strength, durability and lightness in weight through long-time service.

Soaring on wings of war, crystal-clear transparent Du Pont "Lucite" methyl methacrylate resin sheeting provides many of America's greatest battle planes with dependable, light-weight enclosures, allowing pilots maximum vision under all conditions.

Shown here are three of the many warplanes now using "Lucite." These pictures will tell you more conclusively than words how Du Pont "Lucite" is proving its mettle on our battlefronts all over the world . . . and how, when peace comes, this versatile acrylic plastic will be ready to serve designers, engineers and manufacturers in more new and unusual ways than ever before have been dreamed.

GET THIS FREE BOOKLET! Du Pont's new 114-page Manual on "Lucite" clearly describes the fabricating, forming, mounting, installing and repairing of "Lucite" in its application to aircraft. Plus—38 pages on mechanical, thermal and miscellaneous properties to aid aircraft designers, engineers, production men, and their established enclosure suppliers. For your *free* copy, write on your business letterhead to: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department-F, Arlington, N. J. . . . or, 5801 So. Broadway, Los Angeles 3, California. In Canada: Canadian Industries Limited, Montreal.

NOBLE ADJUNCT to the shark-like lines of the world-famous Bell *Airacobra* is its crystal-clear canopy of "Lucite." High shatter-resistance is one of the properties which make "Lucite" particularly adaptable for use in fighter planes like this.

FAST AND FURIOUS, the Lockheed *Lightning* carries "Lucite" to war from the Solomons to Sardinia. As shown here, "Lucite" can be formed into broad surfaces, often with transparent ribs of "Lucite"—reducing "blind spots" for more perfect vision.

DU PONT

REG. U. S. PAT. OFF.

"LUCITE"

methyl methacrylate resin

BETTER THINGS FOR BETTER LIVING

...THROUGH CHEMISTRY

Get all these benefits

by heating your PLASTIC materials with

THERMEX HIGH FREQUENCY equipment!

Fourteen important advantages gained by heating plastic materials with Thermex high frequency equipment are listed below. As pioneers of high frequency equipment for industrial heating, the experience and facilities of the Girdler Corporation's *Application Engineering Service* may be of great benefit to you. This service is available without obligation. *Inquiries are invited.*

1 **PREHEATING AND CURING TIME CYCLES** can be reduced *more than 75% in many cases!*

2 **CURING TIME** in the mold greatly reduced, for material is at molding temperature when transferred into the mold!

3 **PREHEATING TIME** greatly reduced, because Thermex high frequency heating operates at unusual speed.

4 **TRANSFER TIME** greatly reduced. The material completely fills the mold, and weld lines are eliminated!

5 **UNIFORM HEATING.** Thermex will heat preforms uniformly thruout the mass, almost *regardless of thickness or area.*

6 **QUALITY GREATLY IMPROVED.** Finished product is *stronger* because of less internal strain and more homogenious structure.

7 **LOWER PRESSURES** can be used—often *as much as 80% of customary pressures*—resulting in savings in press costs and less wear on molds.

8 **PLASTICITY OR FLOW PROPERTIES** of the material are greatly increased due to uniform and speedy heating by Thermex.

9 **PRODUCTION CAN BE INCREASED** substantially *without* additional molds or presses.

10 **LARGER MOLDINGS CAN BE MADE,** either in thickness or area, with high frequency heating.

11 **AS THICKNESS OF MATERIAL INCREASES** the advantages of high frequency heating *increase.* This is *not* true of other methods of heating.

12 **MORE THAN ONE PRESS CAN BE OPERATED** from one Thermex unit in many cases where circumstances permit.

13 **MORE FLEXIBLE OPERATION** is possible thru *widening the variety* of plastics that can be handled efficiently, and *increasing the size* of the charge that can be heated uniformly.

14 **SIMPLICITY OF DESIGN.** Thermex machines best suited for use on plastic materials have single knob control, only one meter and are semi-automatic. *Skilled operators not needed.*

Above, small portable Thermex unit. Wide range of sizes available.

THERMEX EQUIPMENT IS DESIGNED FOR THE FREQUENCY BEST SUITED FOR YOUR JOB.

The GIRDLER CORPORATION

Pioneers in Industrial High Frequency Heating

THERMEX DIVISION LOUISVILLE, KENTUCKY

Rugged Lumarith plastic boxes for Air Corps repair kit. Transparency saves fumbling when minutes are priceless

MORE and more, custom molders are turning out—complete in one molding shot—plastic parts and entire products, with properties that will take a beating! Lumarith plastics are so often the chosen medium for their skill, because Lumarith is outstanding in impact strength as well as moldability.

If you need "hurry-up" war production parts, chances are they can be molded from plastics—by injection, compression, transfer or extrusion. Here's how to find out:

1. Tell us what qualities you want in the part—impact strength; resistance to solvents, acids, water; light transmission; dielectric strength, etc. We select the plastic to give desired result.

2. We put you in touch with the available custom molders best equipped to mold the piece.

3. The custom molder gives you a quotation.

4. We work with the custom molder in furnishing the formulation of the selected Lumarith plastic that suits all factors of the production technique.

Inquiries invited.

LUMARITH *Plastics*

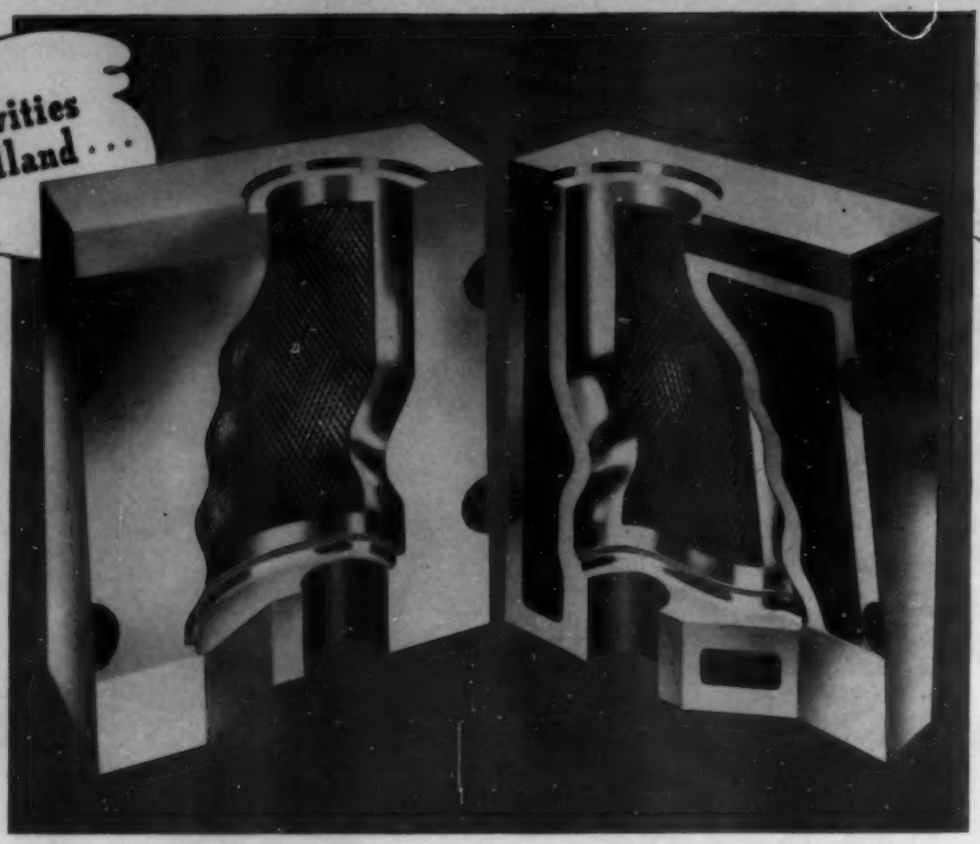
REG. U.S. PAT. OFF.

CELANESE CELLULOID CORPORATION, *a division of Celanese Corporation of America*, 180 Madison Avenue, New York City. *Representatives:* Cleveland, Dayton, Philadelphia, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.

CELANESE CELLULOID CORPORATION

the first name in plastics

A DIVISION OF CELANESE CORPORATION OF AMERICA



Coming to Grips WITH A TOUGH ASSIGNMENT

Plastic mold jobs calling for intricate engraving and deep hobbed cavities are coming more and more frequently to Midland, our experience and facilities being especially suited to their execution. This set of molds for aerial gunner's grips, for instance, required more than ordinary engraving skill and sinking ability.

Our satisfaction in having accomplished this difficult assignment is qualified by the realization of the far tougher assignment likely to be faced by the gunner whose hands will actually use the grips, to deal death and destruction to our enemies. We welcome the opportunity to put everything we've got into our part of such a job . . . so *his* job will be as easy and as certain, as quickly accomplished as possible.

. . . Send your tough mold jobs to Midland!

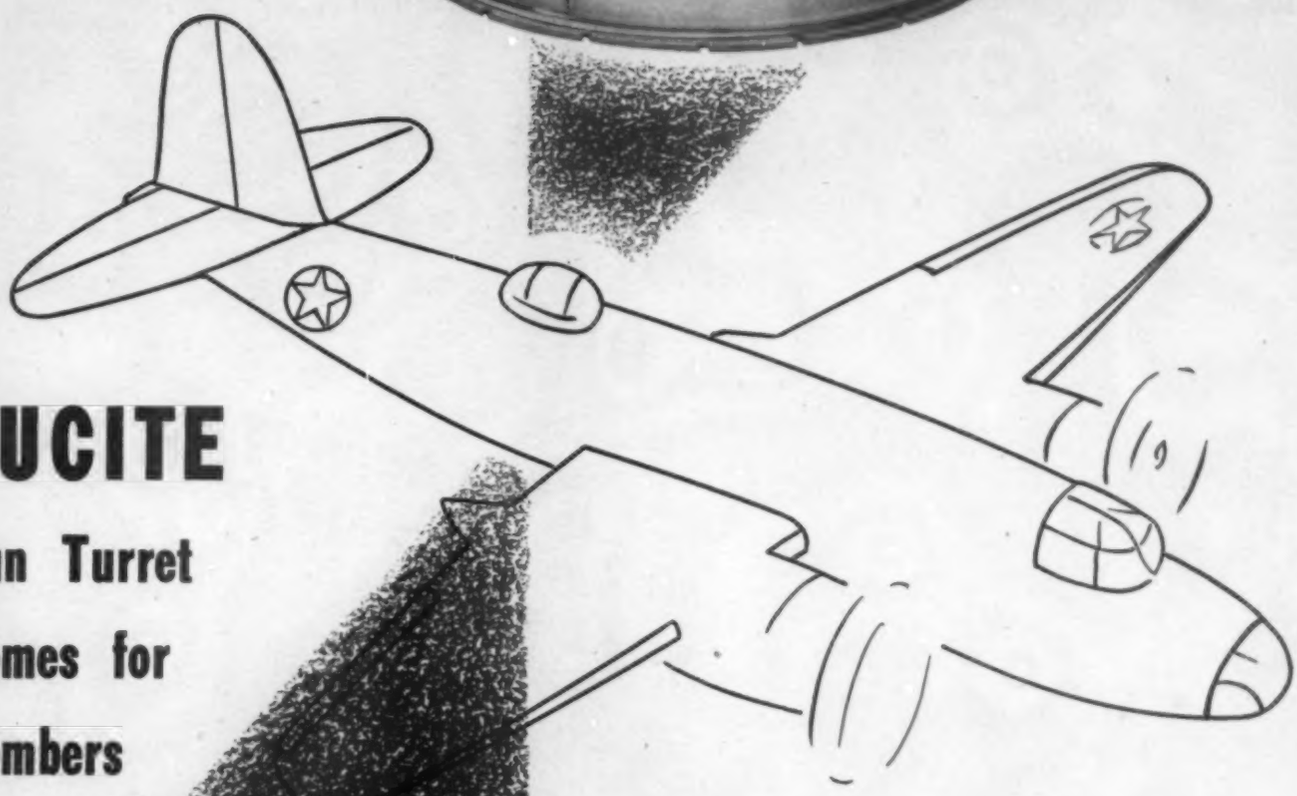
D&E

MIDLAND DIE AND ENGRAVING COMPANY

1800 W. BERENICE AVENUE . . . CHICAGO, ILLINOIS

Makers of Plastic Molds • Die Cast Molds • Engraved Dies • Steel Stamps • Hobbings • Pantograph Engraving

LUCITE Gun Turret Dome for Bombers as manufactured by Reynolds Molded Plastics Division, Reynolds Spring Company of Cambridge, Ohio.



LUCITE

Gun Turret Domes for Bombers

are being finished by the LEA Method *with* LEA Materials

Reynolds Molded Plastics Division, Reynolds Spring Company of Cambridge, Ohio, is doing its share in important war work, turning out gun turret domes for bombers made of LUCITE, a well-known and widely used Du Pont plastic.

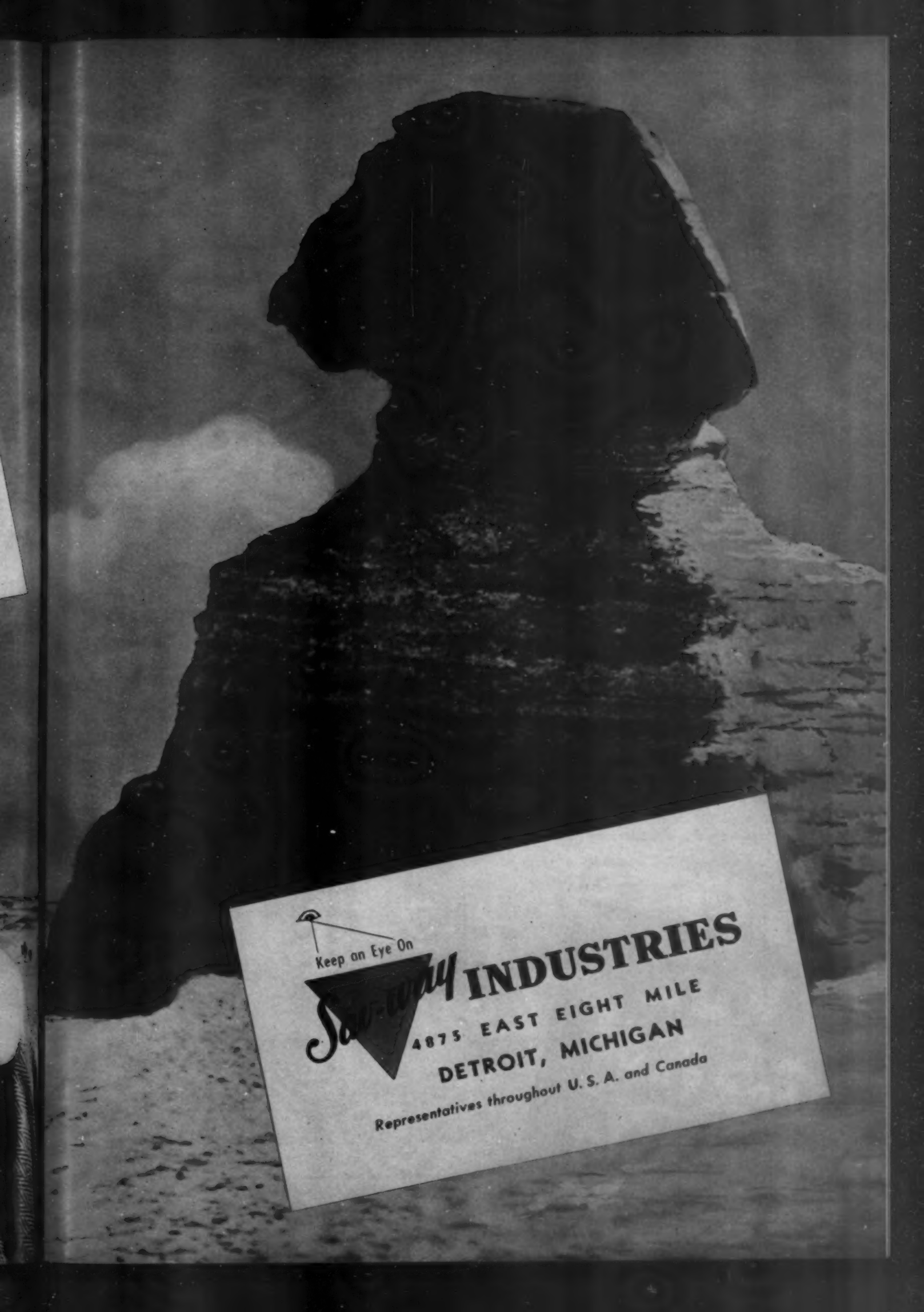
Such Products need careful finishing with just the right material. Costs must be watched. That the LEA Method, making use of LEA Materials, was adopted by the Reynolds Spring people is, we like to feel, a tribute to our technical help along finishing lines. Here is another of the many instances where, with our broad experience with cutting down, polishing and buffing problems, we have helped war industries working with plastics.

If your product requires any degree of finishing, why not let us see if the LEA Method with LEA Materials won't do a better job more economically?

THE LEA MANUFACTURING CO.
WATERBURY CONNECTICUT

Burring, Buffing and Polishing . . . Specialists in the Development of Production Methods and Compositions

WHAT'S HIS SECRET?
HE'S THE ONLY ONE WHO'S SEEN THE NEW LINE OF SAV-WAY MACHINES AND HE WON'T TALK.


Keep an Eye On
Saw-way INDUSTRIES
4875 EAST EIGHT MILE
DETROIT, MICHIGAN
Representatives throughout U. S. A. and Canada

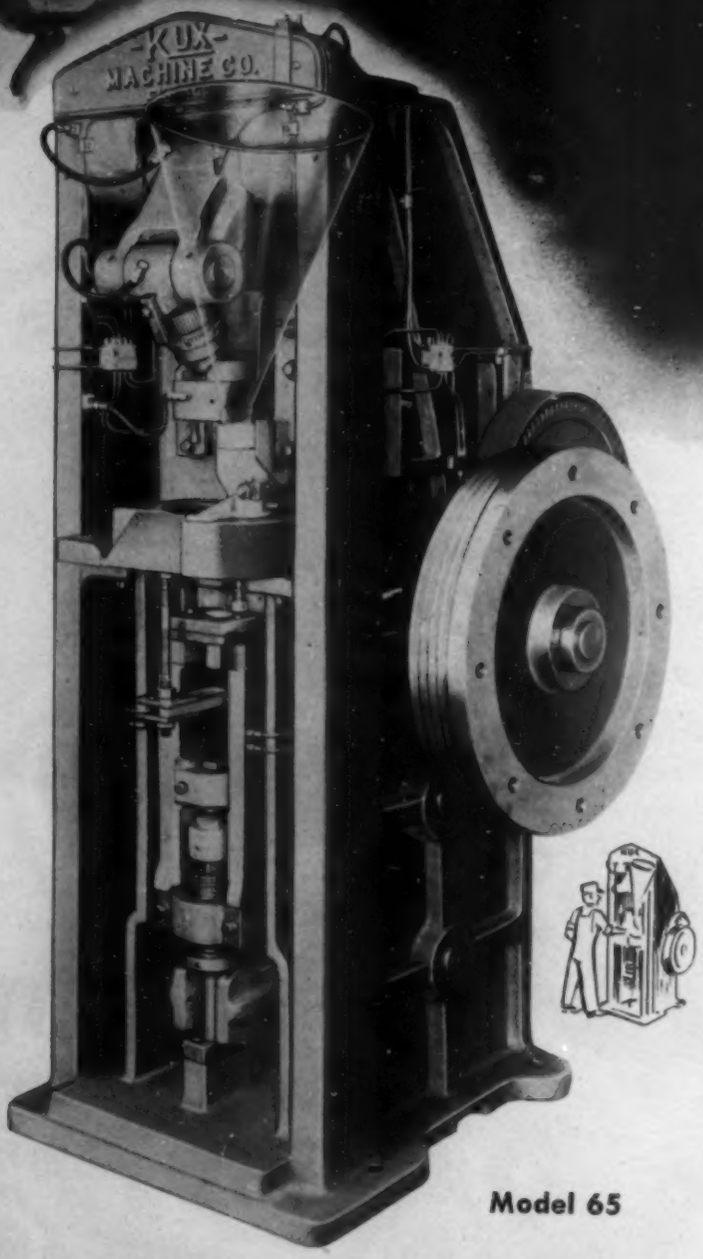
PLENTY RUGGED

Kux Preform Presses

THE NEW MASSIVE MODEL 65 PRODUCES PREFORMS 3" DIAMETER, HAS A 3" DIE FILL AND APPLIES 75 TONS PRESSURE

This rugged preform press with its heavy duty, one-piece cast steel main frame will produce odd shapes as well as round preforms. The pressure applied by both top and bottom punches results in more solid, dense preforms, which have less tendency to crumble or break during handling. This new Model 65 press is built to safely withstand high pressures of up to 75 tons at top production efficiency.

Choice of a complete size range of machines in both single punch models and multiple punch rotaries is also available.

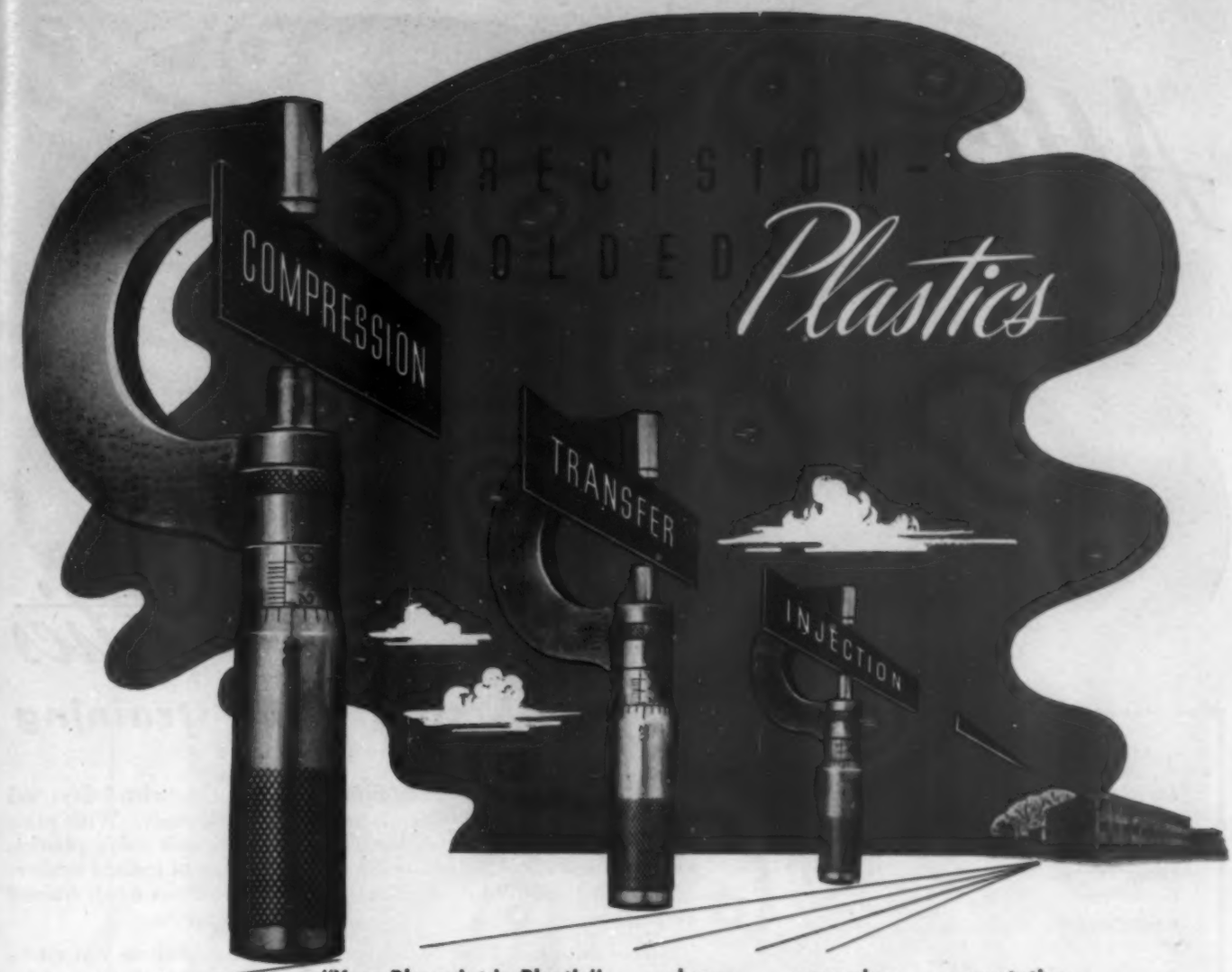


Model 65

KUX MACHINE COMPANY

3924-44 W. Harrison St., Chicago

● Write Dept. P for catalog or demonstration



"Your Blueprint in Plastic" . . . a slogan . . . a promise . . . a reputation — built up by years of application. And now still further enhanced since we've been devoting our major effort to essential war production for the most critical customers it has ever been our privilege to serve! • Whether your plastic part or product requires compression, transfer or injection molding, we have the knowledge, the experience and the facilities to see any job through from start to finish. • Inquiries relative to immediate or post-war molding problems are welcomed. We'd like you to know more about "the Consolidated way"!

Consolidated

Molded Products Corporation

"Your Blueprint in Plastic"

309 CHERRY STREET, SCRANTON, PA.

NEW YORK	BRIDGEPORT	CLEVELAND	DETROIT	CHICAGO
1780 Broadway	Rocky Ridge Drive	3682 Ingleside Road (Shaker Heights)	2970 West Grand Blvd.	549 West Randolph St.

Attention: All Employees

Expand your knowledge of Plastics with spare-time training

THE CURRICULUM INCLUDES:

MOLDING — Study of molding materials and flow properties.

CASTING — Production techniques.

LAMINATING—Procedure of impregnating fabrics, paper, asbestos and wood.

FABRICATION—Thermoplastic qualities of plastic materials.

DESIGN—Functional and artistic requirements.

TESTING—Why plastics differ from other materials of construction and how test methods differ.

ALSO historical background. Polymerization phenomena and the formation of plastics. Introduction to organic chemistry. Formation of phenolic plastics. Urea resins and their characteristics. Polyvinyl resins and their characteristics. Acrylic and polystyrene resins. Cellulose plastics—origin and chemistry. Utilization of farm products and waste materials in plastics. Synthetic rubbers and rubber-like materials. Electrical properties of plastic materials. Chemical properties of plastic materials. Optical properties of plastics. Styling and art in plastics.

The extra time on your hands during these travel-restricted days and evenings can pay big dividends in plastics home study. With practically everything from telephones to airplanes now using plastics, and with undreamed of future expansion, an army of trained workers must be supplied. More than most industries, plastics needs *trained* employees.

To meet this need, Plastics Industries Technical Institute was established; the first plastics training schools, with courses that cover the field in easy-to-understand lessons. On the technical staff are plastics specialists with years of experience, while the Advisory Board is almost a Who's Who of the plastics industry.

Scientists are doing their part in finding new plastics and new uses. Factories are "tooled up" for plastics operations. But lacking in many cases—and the need will grow with the coming of peace—are plastics technicians to make and mold this modern magic.

Whether already in a plastics job or in some other work, study of plastics may be a royal road to promotion for ambitious men and women. Write today for complete information and the illustrated booklet "World of Plastics"—and find out how you can improve your worth to yourself and the nation through the Plastics Institute home study program.

Plastics
INDUSTRIES TECHNICAL INSTITUTE

New York . . . 1220-A Chanin Bldg., Dept. 7
Los Angeles . . . 182 S. Alvarado St., Dept. 7
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Reprints of this message for your bulletin boards available upon request

AMERICA'S ORIGINAL PLASTICS SCHOOLS

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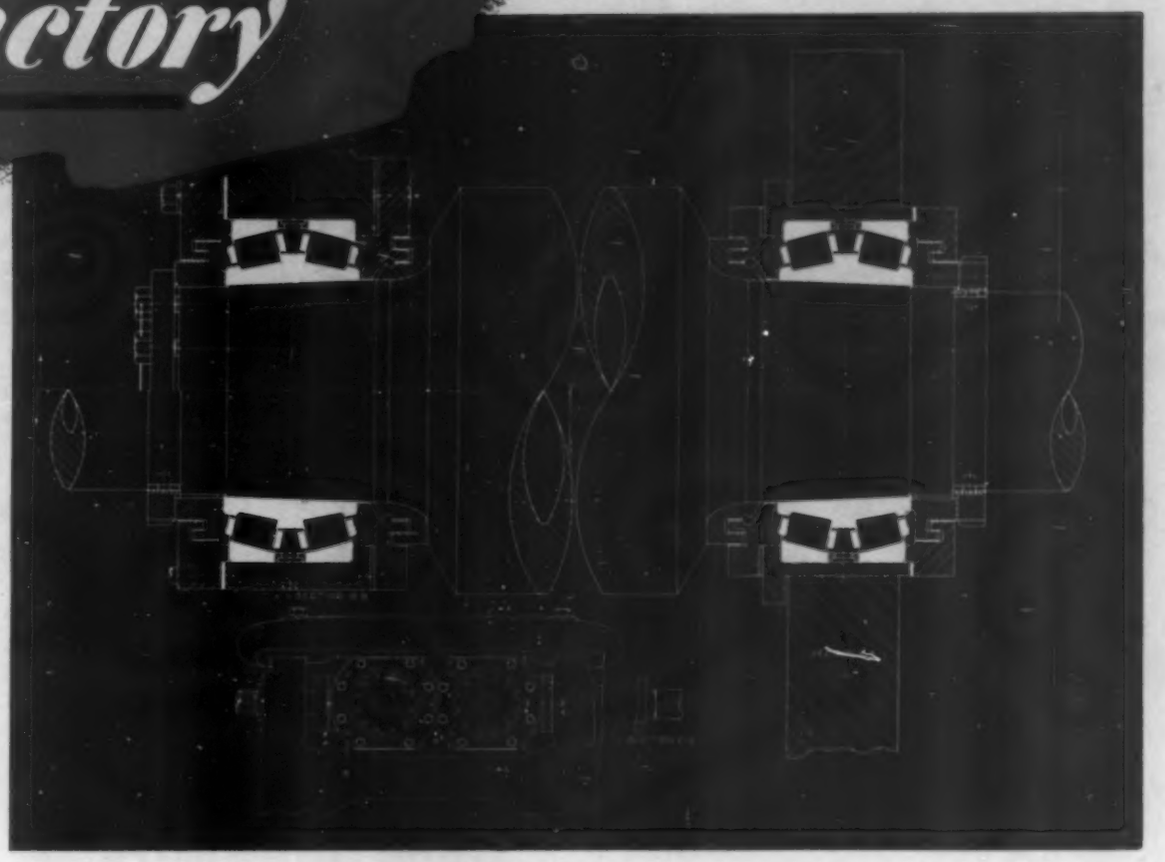
KEEP YOUR PLASTICS MILLS ROLLING FOR *Victory*

Typical application of Timken Bearings on plastics mill roll necks.



By mounting Timken Bearings on the roll necks of plastics mills several important advantages can be secured. They are: faster, smoother operation; reduced power consumption; simplified lubrication; greater precision; lower maintenance; increased endurance; freedom from lubricant leakage and resultant contamination of the product.

If the builders and users of steel rolling mills had been content to stick to obsolete plain bearings, steel production would be far from what it is today — in quantity and quality. In fact the modern four-high continuous strip mill would not have been possible without roller bearings. So why continue to use plain bearings in plastics mills? The Timken Roller Bearing Company, Canton, Ohio

What after Victory? Don't wait to find out—it may be too late. Prepare now with redesigned equipment containing a full complement of Timken Bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

We are doing postwar planning, too.

● There is a lot of discussion of postwar planning, most of it pretty indefinite, necessarily.

We are doing postwar planning of a kind with some degree of certainty. We don't profess to forecast the shape of things to come, or just who is going to make what.

What we are certain of is that manufacturers of the thousands of articles to which plastics are adapted, are going to continue to appreciate the service that has made General Industries a dependable source of supply in molded plastics throughout years gone by.

Consequently, we are planning to maintain our high standards in producing molded plastics parts in any quantity, finely finished, accurate in dimension and conformation, and delivered "On Time."

General Industries
MOLDED PLASTICS

THE GENERAL INDUSTRIES CO.
Molded Plastics Division • Elyria, Ohio

Chicago: Phone Central 8431 — New York: Phone Longacre 5-4107
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Above: Morris Ketchum, Jr., and Lustron battery case for walkie-talkie radio. Recognized as an expert in the design of modern commercial buildings, Mr. Ketchum is associated with the New York architectural and engineering firm, Harrison, Fouilhoux and Abramovitz and is an instructor of Architectural Design, New York University.

FROM A WALKIE-TALKIE BATTERY ...A CAMERA STORE FOR 194X!

STORIES of a number of wartime plastics uses contributed to this conception of a camera store for 194X by New York Architect Morris Ketchum, Jr. One which particularly fired his imagination, however, was a battery case for compact walkie-talkie radios molded from Lustron, Monsanto's lightweight, water and weather resistant polystyrene.

Starting with a ceiling of translucent Lustron panels which make use of those same qualities, Mr. Ketchum has gone on to visualize a complete store based on the logical development of wartime advances in several other Monsanto plastics as well.

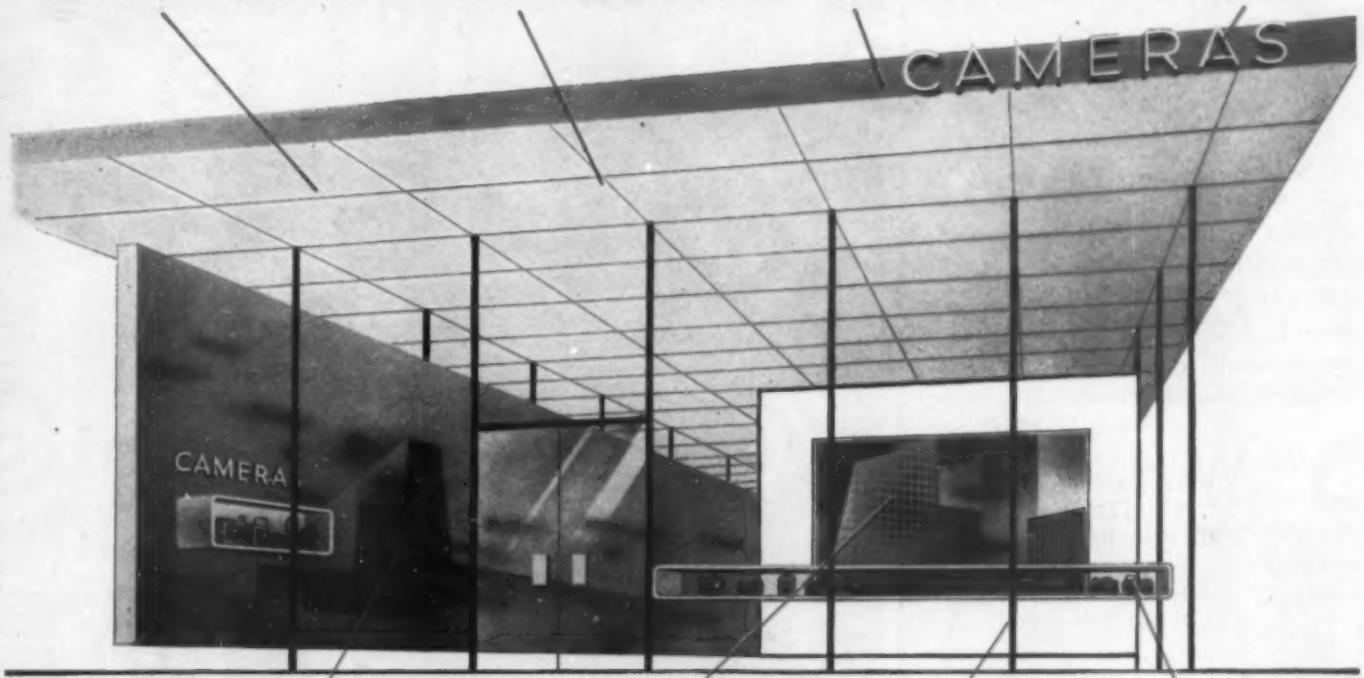
Mr. Ketchum's store, however, is by no means an all-plastics creation. Where other materials promise to serve better than the plastics we may expect to have available in the near future, those other materials have been specified.

Ceiling: Standard size, clip-on panels of translucent Lustron — chosen for its lightweight, dimensional stability and acid resistance — carry over both the outside lobby and the interior. Above panels is overall lighting system including both incandescent and fluorescent illumination.

Ceiling moldings support panels, also serve as continuous wireways or plug-in strips for downlight fixtures. They might be formed from any one of three Monsanto plastics, Lustron, Resinox or the newest of the family, melamine. As panels are removable, lighting system is easily rebuilt.

Canopy fascia: plastics-bonded plywood which could be surfaced in any desired color with new types of recently developed weather, water and age resistant melamine resins.

Canopy letters: molded from translucent, colored Lustron. Thanks to Lustron's ability to "pipe" light, they could be edge-lighted from a concealed source in the canopy fascia.



Photomural wall, eight feet high and the length of the store, is mounted on continuous length of Resinox or melamine-bonded plywood. A film of transparent plastic protects it from wear and careless hands. As a result, it can be cleaned with soap, water and scrubbing brush.

Projection screen: Rear wall of sales area is a large, recessed screen on which could be shown still or motion pictures. Screen, perhaps of a plastics composition, is recessed to increase its luminosity and might also be mounted on light, dimensionally stable, plastics-bonded plywood.

Supporting columns: thin, strong columns of steel or one of the new, light metal alloys. Where maximum strength per unit of area is desired, metals are still superior to plastics.

Door, glazing, and showcases: might some day be formed from non-shatterable, flexible or semi-flexible sheets of transparent plastic but in predictable future should be glass.

The Broad and Versatile Family of Monsanto Plastics

(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)

LUSTRON (polystyrene) • **SAFLEX** (vinyl acetal) • **NITRON** (cellulose nitrate) • **FIBESTOS** (cellulose acetate) • **OPALON** (cast phenolic resin) **RESINOX** (phenolic compounds)

Sheets • Rods • Tubes • Molding Compounds • Castings • Vuepak Rigid Transparent Packaging Materials

MONSANTO PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

WHAT EVERY PROPHET SHOULD KNOW

Frankly, much development work has yet to be done in laboratories of established building materials suppliers and plastics manufacturers alike, before the store Mr. Ketchum has sketched opens for business. As one of the nation's largest producers of plastics, however, Monsanto is interested in encouraging intelligent, creative prophecies like Mr. Ketchum's. For only when the logical possibilities *and* limitations of plastics are fully understood can they contribute to the fullest to a better postwar world. MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

MEDAL... *for turning down business*

That's a Hell of a thing to get a medal for.
We've spent twenty years running around the trade
with our tongues out—searching for business—
And now we must pull back into our shells
and watch business—nice business—trip
merrily past our door—restraining our tears—
Like little men.

Who wants to be a man today—or a woman—
if that's the price.
Well—maybe it's all right at that—
We are working for the boys at the front
and certainly no one can do too much
along that line.

So—if you expect to consider plastics after
Hitler's and Hirohito's permanent and forcible extinction
Let us know—we'll serenade you—buy you drinks
in nice fresh three month whiskey—
Anything to get in right and pick up an order.
Keep us in mind, please.

"A Ready Reference for Plastics" written for the layman, is now in a new edition. If you are a user or a potential user of molded plastics, write us on your letterhead for a copy of this plain non-technical explanation of their uses and characteristics. Free to business firms and government services.

BMCD

ARMY E NAVY

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MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

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ARMY E NAVY

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CRYSTAL-CLEAR to permit uninterrupted vision, strong and rigid to be self supporting and to withstand air pressures, easily fabricated to the required shape, PLEXIGLAS proved its worth in the RCA-Victor altitude test chamber.

This is the same success formula that has enabled hundreds of manufacturers to use, profitably, PLEXIGLAS —and its sister plastic CRYSTALITE— in applications ranging from safety shields on fast-moving machinery to display stands in America's finest stores . . . from dials on leading motor cars to hair brush-backs in brilliant jewel tints . . . from edge-lighted signs at the point of sale to electrical insulators with high, permanent dielectric strength.

Let Rohm & Haas representatives show you how your product—present or postwar—can also benefit by the use of PLEXIGLAS or CRYSTALITE. Branch offices are in Los Angeles, Detroit, Chicago and New York.

THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS
SHEETS AND RODS

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MOLDING POWDER

PLEXIGLAS and CRYSTALITE are the trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by the Rohm & Haas Company.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries

Which Way are YOU Going?

Post war products and markets promise the greatest change in all merchandising history. Far sighted planners everywhere are deciding NOW the direction they'll be going for volume sales and profits, when the shooting has died away.

The infinite possibilities of plastics, in all their beauty, color, and strength, make them ideally suited to almost endless product applications. When thinking of *your* post-war products, consider not only metals, glass, wood, and the old materials. Consider also the modern material. PLASTICS..SINKO economical Injection Molded Plastics! Our skilled staff are pioneers in the successful planning and producing of intricate injection molded electrical products and parts. Combining metals and thermoplastics is another SINKO specialty, executed with skill and precision we believe unapproached in the history of our industry. Shall we look to the future *together*? Writing now to us or our nearest representative will bring you quick cooperation.

Sinko

PRECISION INJECTION MOLDING

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If your present manufacturing operations or postwar plans involve product parts where light weight is essential, consult Westinghouse.

Skilled Micarta engineers will be glad to study your product and to analyze its applications. And they will give you the benefit of 35 years' experience with industrial plastics.

This experience is particularly extensive with respect to aircraft applications . . . for example,

MICARTA IS THE IDEAL MATERIAL for airplane fairleads, guides and pulleys. Its weight is only one-half that of aluminum.

ON FIGHTERS AND BOMBERS, literally millions of Micarta parts are in constant use. Micarta is also used for control and instrument panels, antenna masts, terminal blocks, spacers and bearings . . .

AND IN MANY OTHER INDUSTRIES . . . hundreds of thousands of Micarta products are in use where light weight and dependability are vital.

In the majority of these applications Micarta is used as a replacement for critical materials and is serving better.

We urge you to find out the facts about Micarta today. Wire or phone your nearest Westinghouse office or write to Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pa., and ask for a copy of the new Micarta Data Book—B-3184. J-06339

TYPICAL MICARTA TOUGH JOBS IN WAR APPLICATIONS

Aircraft structural parts	Protective helmet liners
Industrial gears	Aircraft control pulleys
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Steel mill bearings	Fuse mountings
Thrust washers	Insulating washers
Marine bearings	

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

Micarta

The INDUSTRIAL PLASTIC

LESTERS Prove Today What They Can Do Tomorrow

Here's a battery of Lester Injection Molding Machines hard at it—turning out wartime plastic moldings in the plant of Pro-phy-lac-tic Brush Company. Ranging from airplane engine starter handles to window frames for prefabricated barracks for the fighting men of America, thermoplastic moldings from these Lesters flow in a steady stream to help win the war of production.

These same modern machines with their many exclusive features* will be ready for quick conversion to profitable peacetime production when the time comes. For Lester Injection Molding Machines are engineered and constructed for versatility, high production and long life.

Lesters are versatile because extra interchangeable heating cylinders, available for each model, greatly widen their operating range. They are high producers because plasticization of the material is rapid and uniform. They offer unusually long service life because they are designed and built to do so.

Proved by long service records before the war and by the gruelling grind of war production, Lesters will be ready for the coming new era of plastics with an experience background of more than 30 years. Write now for complete plans and specifications.

This 16-inch window frame is injection molded of polystyrene on a Lester. Glazing is transparent ethyl cellulose.

The airplane engine starter handle, also Lester injection molded, is produced in a 2-cavity mold of cellulose butyrate.

Produced in a 2-cavity mold on a Lester, this heavy brush back is an Acrylic Resin.

Check these Lester Advantages—(1) Vertical heating cylinder with hollow injection plunger, resulting in high heating efficiency. (2) Positive die locking, minimizing flash on moldings. (3) Central die adjustment, assuring absolute parallelism of die plates. (4) Heavy alloy steel beam frame, giving rigid support to die locking mechanism. (5) Wide range of sizes—4, 6, 8, 12, 16 and the new 22-ounce size for larger moldings.

LESTER

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For the Shapes of Things to Come-
You'll want this information
Continental-Diamond FIBRE COMPANY
Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

The tougher they come the harder we fall for them

Life in a molding plant these days is not all beer and skittles. Many a job presents new riddles, new mechanical problems, whose answers must be found before production can begin. Yet time must not be lost in figuring ways and means, or in molding and delivering plastics that fall short of meeting full requirements. Plastics that don't quite get the moon over the mountain are an inexcusable hindrance to the war effort.

That's a main reason for giving us at Auburn the tough ones. We like them because we lick them. We started molding plastics in 1876—grew up with the industry—went through the years when almost every job required special engineering and design. There are a thousand and one experiments we don't have to make today. We made them long ago!

If you have a molded plastic problem whose solution will help the war program, let's get together. We'll figure it out—and when you get deliveries you'll find our finishing and inspecting as good as our planning!

MOLDED PLASTICS DIVISION

AUBURN BUTTON WORKS, INC.

Molders of All Types of Plastic Materials by Compression, Transfer Injection and Intrusion Methods

ESTABLISHED 1876 AUBURN, NEW YORK

WEIGHING THE FUTURE . . . . .

It will be a future offering more to coming generations . . . a future providing more conveniences for more people . . . a future in which plastics will play a vital part. To manufacturers using plastics . . . to plastic molders and fabricators . . . Nixon offers an improved line of thermoplastic materials. If you have a design or production problem involving the use of plastics we will be glad to help. Get in touch with us or our nearest representative.

MATERIALS: Cellulose Acetate • Cellulose Nitrate • Ethyl Cellulose
AVAILABILITY: Sheets • Rods • Tubes • Extruded Profiles
Cellulose Acetate and Ethyl Cellulose Molding Powder

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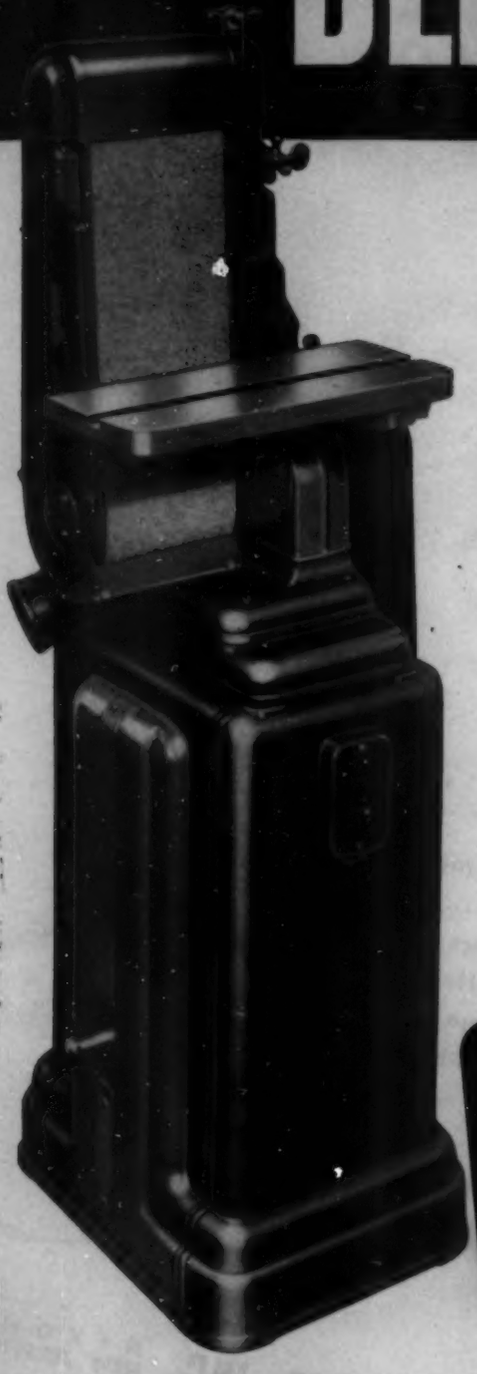
Substantial Savings in Time and Money -with the DELTA *Abrasive Belt Finishing Machine*



Widely used for finishing, finning, and surfacing plastic parts

Heavy — husky — capable of doing any of the dozens of sanding, polishing, and finishing operations to be found in the average shop — yet portable, so you can move it where you want it when you want it . . . that's the Delta 6" Belt Finisher.

You can use it for a wide variety of finishing operations—on plastics, metal, or wood. It's designed for long life, low power consumption, and accurate, dependable results—a high-grade machine tool for high-grade work, yet costs a fraction of the price you may have been accustomed to paying.

Get the Delta catalog, and check this machine point by point for quality. You find it's completely equipped with double-sealed ball bearings, lubricated for life at the factory — completely enclosed and guarded in accordance with all safety requirements — substantially built with extra heavy drive shaft, large diameter drum, large driving pulley — provided with efficient dust deflector and suction spout — etc., etc.

Install one or a battery in your plant — for results that reflect credit on your choice. See it at your Delta industrial distributor's — check priorities and deliveries. Write today for the Delta catalog.

P-1

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Please send me your catalog showing the Delta Abrasive Belt Finishing Machine, and other low-cost Delta Machine tools.

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Used Horizontally or Vertically

In this position, may be equipped with a wood fence for face or edge sanding, if required.

Rear view, showing adjustable back stop with bracket, to hold flat work in position against motion of the belt.

. . . as shown in main illustration. Above: Close-up of the 7½" x 14¾" tilting table, showing trunnion, swinging stop link, and adjustable stop screws.

K·E·M

The only successful non-critical molding material yet developed.

PROVED IN USE

The many molders who have kept their production rolling with K.E.M.—MAKALOT'S special "Keep 'Em Molding" non-phenol molding compounds—know what these materials can do. Everything from the long, narrow Bomb-Booster to small bottle closures have been molded of K.E.M. by compression and Jet Process.

PROVED BY TEST

K.E.M.'s fine qualities are also proved by non-commercial analysis. The following figures are taken from laboratory results provided by researchers of Plastics Industries Technical Institute of Los Angeles.

1. Arc Resistance (Project X-330)
   Equipment and Methods: High Voltage Transformer, Test Electrodes . . . 200″ spacing.
   Report: Time in seconds for Breakdown.

K.E.M.	Cast Phenolics	Cel. Acetate	Cel. Acetate Butyrate	Casein	Urea	Polystyrene	Acrylic
17.2	1.2	2.8	1.5	2.2	10.5	2	2

2. Force Required to Pull Out Inserts (in pounds) (Project X-326) (Partial Results)

K.E.M.	Phenolic Mineral Filler	Phenolic Tire Cord	Phenolic Sisal	Phenol Furfural
790	450	775	780	700

3. Flow properties of Makalot K.E.M. (Project X-327) Flow 90
   * RESULTS:

Molding Pressure (p.s.i.)	Flow (inches) in 10 seconds	Flow (inches) in 20 seconds	Maximum Flow (inches)	Average Maximum Flow
500	.06	.20	.54	
	.06	.18	.58	.55
	.06	.19	.52	
1000	.14	.42	1.44	
	.18	.53	1.35	1.38
	.16	.47	1.35	
1500	.17	.54	Over 1.50	
	.20	.60	Over 1.50	Over 1.50
	.15	.57	Over 1.50	
Precure 45 seconds	1.02	1.06	1.07	
1500	1.13	1.17	1.18	1.12
	1.06	1.09	1.10	
Precure 60 seconds	.19	.20	.20	
1500	.17	.18	.18	.17
	.12	.13	.13	

olding temp. 150° C ±
on Peakes-Rossi Flow
ster.

PHENOLIC IMPREGNATING RESINS · MOLDING COMPOUNDS · FABRIC & PAPER IMPREGNATING RESINS · UREA RESINS & ADHESIVES · PHENOLIC LACQUERS · VARNISHES

"KEEP 'EM MOLDING"

Makalot

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Bull-dog tenacity . . . that's what brake lining manufacturers want in a phenolic resin. A Herculean grasp that welds the many fragments of their products into a tough, hard fibre that offers the maximum resistance to the red hot wear and tear that goes on inside a brake drum.

Many of this nation's most famous brake linings get that bull-dog tenacity . . . that Herculean grasp from Varcum custom-made resins. These top flight manufacturers have found that Varcum constant high quality, dependable delivery and ever ready eagerness to solve new and unusual problems, make this the perfect source of supply. Let us tackle your next resin problem!

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NIAGARA FALLS, NEW YORK

CUSTOM-MADE RESINS FOR THE WORLD'S FINEST PRODUCTS

FRAMED IN EXTRUDED PLASTICS

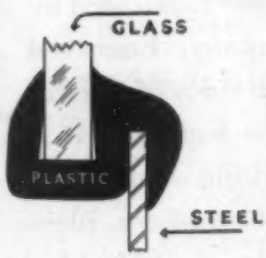
SUBSTITUTING FOR RUBBER

The border around this text is a photograph of a glazing channel, extruded of a rubberlike plastic by MACOID. This unique application protects glass windshields and windows in Army trucks, jeeps and ambulances and in buses for essential wartime travel. It is an effective seal against weather — a perfect substitute for rubber.

A special flexible plastic material is extruded in continuous lengths in a wide variety of profiles to fit specific needs. Lengths are cut and welded into units into which the windows fit and which, in turn, fit into metal body frames.

MACOID proves again, with this application, not only the superiority of extruded plastics but our own mastery of the process. This is another in the long line of extruded plastic achievements which MACOID has contributed to the automotive industry, furniture, refrigeration, household supplies and many others.

We also do injection molding.



Cross-sectional drawing showing channel holding glass window and set into steel frame.

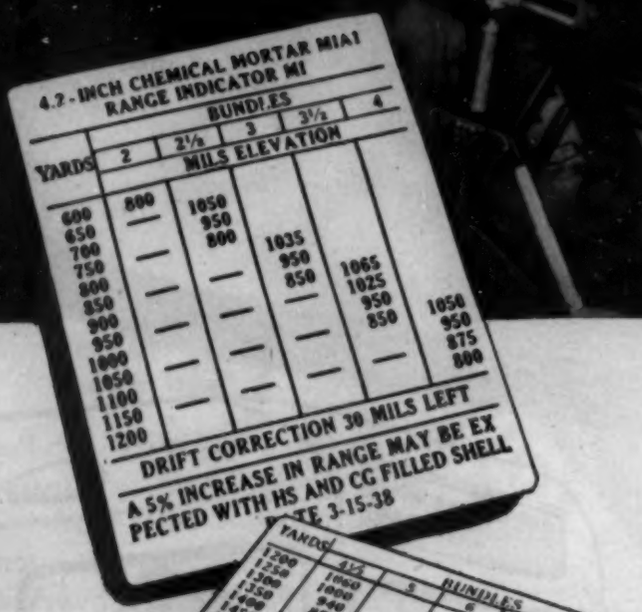
DETROIT MACOID

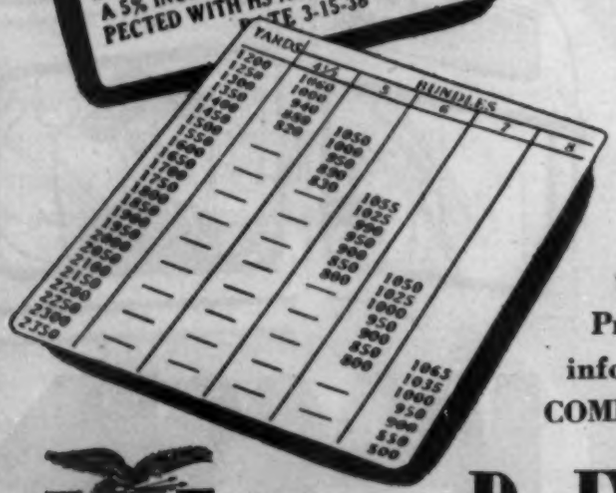
CORPORATION

12340 Cloverdale Ave. Detroit, Michigan

ORIGINATORS OF DRY PROCESS PLASTIC EXTRUSION

THE PEERLESS MARKING PROCESS MEETS THE DEMANDS OF WARTIME SERVICE!





One of hundreds of war items marked with Peerless roll leaf is this range finder card fabricated by E. B. Kingman Company. Engraved with black leaf on both sides of a cellulose acetate card, it is as legible as it is indestructible. For marking dials, condensers, name and instruction plates, identifying insignia, etc., the Peerless Marking Process meets every war requirement. For full information write to PEERLESS ROLL LEAF COMPANY, Union City, New Jersey.

Stamping Presses — *Roll Leaf Attachments*

Genuine Gold — *Imitation Gold*

Color Stamping Foils

PEERLESS

Branch Offices: 352 Massachusetts Avenue, Cambridge, Mass.; 608 So. Dearborn Street, Chicago, Ill. *Distributors:* Advance Sales, Inc., 2309-11 Locust Blvd., St. Louis, Mo.; Chas. H. Zipser Co., 733 Santiago Street, San Francisco, Calif; Printers Supply Corporation, 1142 Maple Avenue, Los Angeles, Calif.; Wilson-Munroe Co., Ltd., 18-20 Duncan Street, Toronto, Ont., Canada.

Amos offers you complete facilities for designing, engineering and producing plastic parts fast and efficiently—anything that can be injection molded from thermoplastic materials such as Ethyl Cellulose, Cellulose Acetate, Cellulose Acetate Butyrate, Methacrylate, Vinyl Chloride, Vinylidene Chloride and Polystyrene.

The Amos picture-portfolio, shown here, contains 56 pages of helpful information on molded plastics for post-war product planners. It tells the story of Amos facilities and abilities completely. Write for it.

AMOS MOLDED PLASTICS, EDINBURGH, INDIANA
Division of Amos-Thompson Corporation

Custom Molders of all Thermoplastics by Injection Process

SERVICE . . . *with a capital "S"*

SANDING WET OR SANDING DRY, by machine or by hand, there's a correct coated abrasive for each job and we'll be glad to help you find that very one.

If you'll simply get in touch with us at the home office or the branch that's nearest to you, we'll have one of our abrasive engineers study any or all of your finishing problems.

Our men are exposed to a great many different and difficult jobs in hundreds of plants. Such experience is freely yours for the mere asking.

In many cases as simple a thing as a change in grit number, type of mineral coating or class of backing—all second nature to them—produces the most gratifying result.

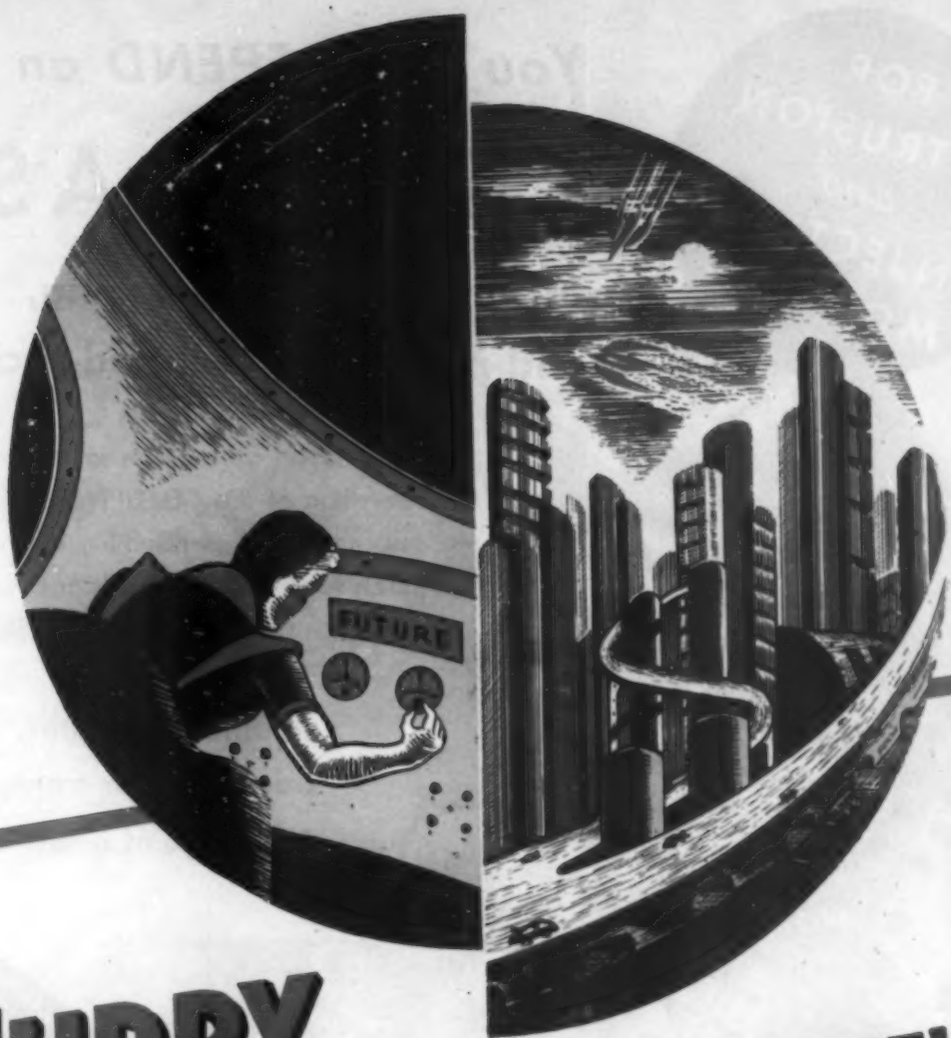
Isn't it good business to have your sanding operations checked for greater output, better finish—or both?

Pioneers in Better Coated Abrasives Since 1872

BEHR-MANNING
(DIVISION OF NORTON COMPANY)
TROY, N. Y.

QUALITY ABRASIVES
NORTON ABRASIVES

BRANCHES: Boston, Buffalo, Chicago, Cincinnati, Cleveland, Grand Rapids, High Point, Indianapolis, Detroit, Los Angeles, New York, San Francisco, Philadelphia, St. Louis, Tacoma.



HURRY,

or you'll be late for the FUTURE!

Who knows, after man has conquered the three familiar dimensions, whether he may not go on to conquer the fourth—*time?*

Perhaps out of the great spurt technology will take after this war, some scientist will discover a machine that will traverse history as easily as an automobile covers ground.

One thing you may be *sure* of: in the surge of post-war industrial and economic expansion, plastics will play a key part.

Plastics will be among the basic raw materials in the buildings, instruments and vehicles of the future.

Start thinking plastics *now*, and be ready for the future when it comes. We'll be glad to help you with your planning—and our facilities are at your service in the production of molded plastic parts and pieces.

STERLING PLASTICS CO.

UNION, NEW JERSEY

FOR EXTRUSION *and* INJECTION MOLDING

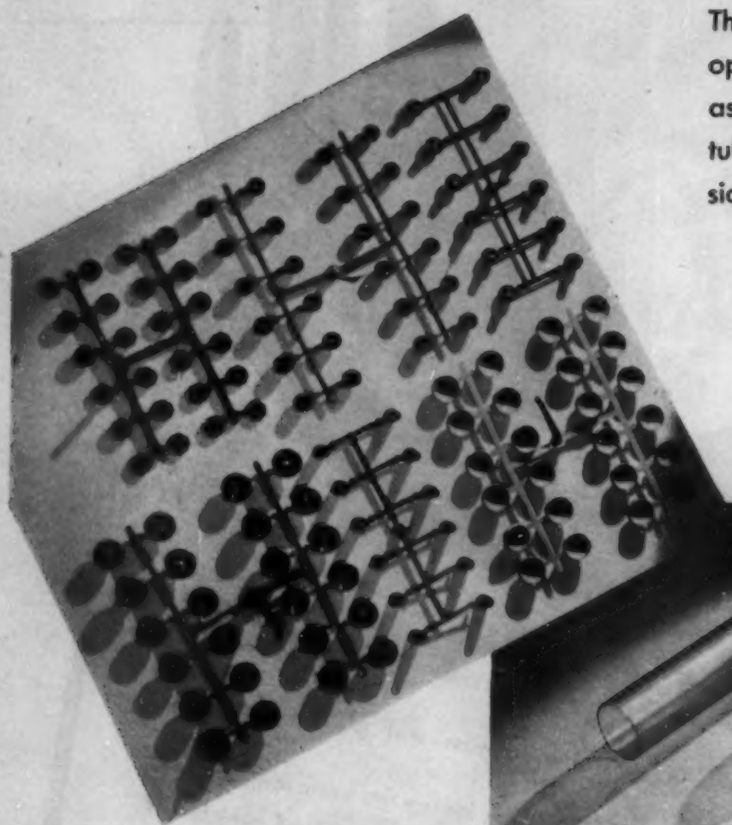
You can DEPEND on

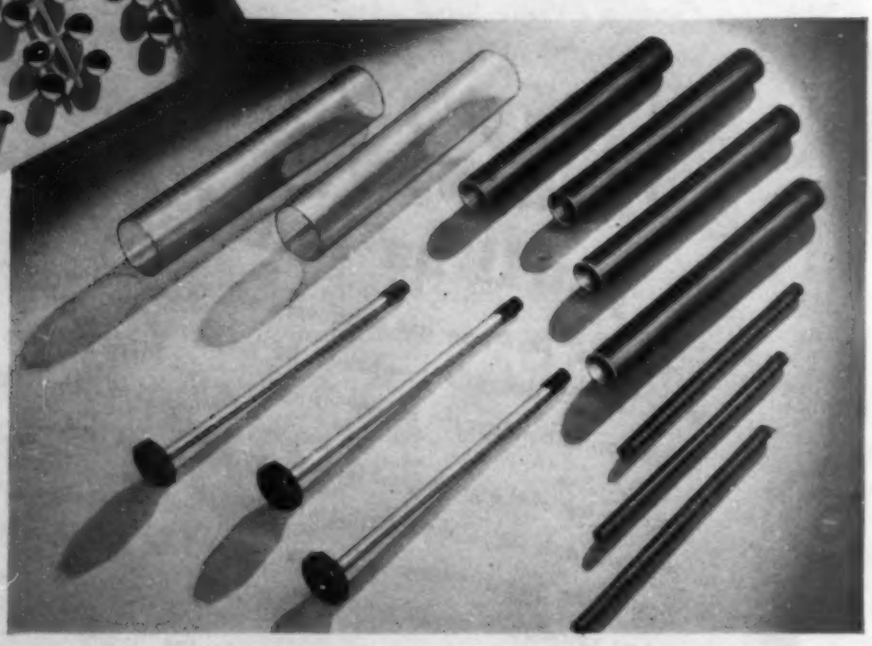
CELLUPLASTIC

for engineering, designing, and production skill and facilities—

There IS an advantage in the wholehearted co-operation of the CELLUPLASTIC staff, and in the assurance of dependability in prompt delivery of tubes, rods, tapes, threads or other forms in precision dimensions of our EXTRUSION MOLDINGS.

continuous lengths, opaque, translucent or transparent, in a full range of colors and shapes.





On INJECTION MOLDING, using your molds, or our own, the skill of years of service, and ability to handle intricate assignments is assured. CELLUPLASTIC quality will give you finer finished products or parts.

Write for details—and lustrous* CELLUPLASTIC *samples

FIRST IN CELLUPLASTICS
HYCOLOID-CLEARSITE

CELLUPLASTIC CORPORATION

EXTRUSION AND INJECTION MOLDERS

60 AVENUE L NEWARK, N. J.

IT'S DONE WITH "MIRRORS"

The mirror-like surface of Hard Chromium Plate is protection against abrasive wear and corrosion. Twice as hard as ordinary steel, it is long-wearing and easier to keep clean and polished.

Plated molds or moving parts that have been in use for a considerable time may be "stripped" and replated with Hard Chromium again and again. Our men are skilled in this technique and careful to preserve the original dimensions.

Any parts requiring metals or man-hours are practically irreplaceable today. You'll be doing yourself a real favor —and your country a genuine service— if you conserve with Hard Chromium. It more than "pays" for itself!

INDUSTRIAL HARD CHROMIUM CO.

"Armorplate for Industry"

15 ROME STREET • NEWARK, NEW JERSEY

Question EVERY FASTENING

You, too, may be able to save tapping-time . . . end breakage of plastic parts . . . simplify design, with P-K Self-tapping Screws

Save 2 to 3 minutes tapping-time per part

"Without P-K Self-tapping Screws, the design of this Acro-snap Midget Switch would be impracticable," says the Acro Electric Co. of Cleveland. Use of P-K Type "F" Screws to fasten the metal contact to the plastic base also saves the two to three minutes that tapping would require. The Type "F" Screws *cuts* a machine screw thread as it is turned in. The fastenings have the security that is needed for this switch, which is used in large numbers on tanks, aircraft, and other important war equipment.

End costly nuisance of stripped threads, broken parts, broken taps

The cover of the battery case on the Ristlite, made by the Flashlight Co. of America, Jersey City, is fastened with Parker-Kalon Type "Z" Self-tapping Screws. These screws were chosen to replace machine screws formerly used – to end the expense of tapping, tap breakage, and breakage of the plastic cases during tapping. The Type "Z" Screw *forms* a thread as it is turned in . . . makes a stronger fastening than a machine screw in a tapped hole or insert.

P-K Screws prove better, faster on 7 out of 10 metal and plastic-assembly jobs!

Check up on *your* assemblies. Can you eliminate tapping, riveting, or bolting? Can you dispense with inserts? Can you obtain stronger fastenings to improve your product?

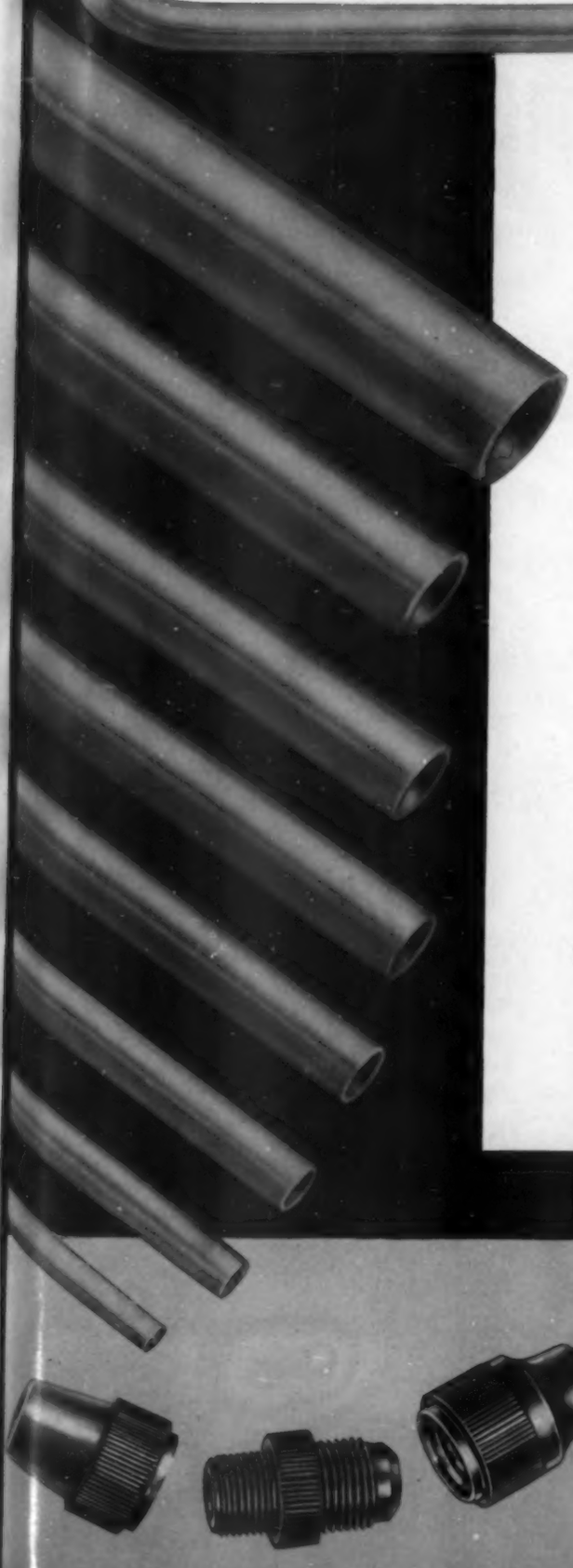
Chances are you CAN! In 7 out of 10 cases where manufacturers "questioned every fastening," Parker-Kalon Self-tapping Screws pointed the way to simplified assembly of metal and plastic parts, fewer operations, faster production, more secure fastenings.

Ask for a P-K Assembly Engineer to call and help you search out all opportunities to gain man-hours, improve products with Self-tapping Screws. Or, send assembly details for recommendations. Parker-Kalon Corporation, 190-200 D Varick Street, New York, N. Y.

PARKER-KALON
Quality Controlled
SELF-TAPPING SCREWS

Give the Green Light . . . to War Assemblies

MILLS-PLASTIC
TUBING and FITTINGS



MILLS-PLASTIC* tubing and fittings are proven practical products because of their adaptability under high bursting and working pressures, superior insulating qualities, extreme resistance to most chemicals, and unusual flexibility and ease of handling. They have replaced vital materials needed elsewhere in the war effort, such as aluminum, brass, copper, nickel and stainless steel. MILLS-PLASTIC is now being featured in hundreds of uses in war, industry, commercial, and domestic fields.

MILLS-PLASTIC tubing and fittings are now available in sizes from 1/8" to 3/4". Tubing comes in coils of 25 ft., 50 ft. and 100 ft. in several wall thicknesses. Special sizes or coil lengths available on request.

* MADE OF SARAN

For more information about MILLS-PLASTIC tubing and fittings, write on your letter head for new six-page circular or for our catalog containing data and illustrations of Injection Molded and Extruded Plastics.

ELMER E. MILLS CORPORATION

MOLDERS OF TENITE, LUMARITH, PLASTACELE, FIBESTOS, LUCITE, CRYSTALLITE POLYSTYRENE, STYRON, LUSTRON, LOALIN, VINYLITE, MILLS-PLASTIC, SARAN AND OTHER THERMOPLASTIC MATERIALS.

812 WEST VAN BUREN STREET • CHICAGO, ILLINOIS

Are you having trouble obtaining
PRECISION PLASTIC PARTS?
NEW METHODS ENABLE US TO MACHINE
PLASTICS TO TOLERANCES AS CLOSE AS .0005
SMALL QUANTITY EXPERIMENTAL PIECES
OR LARGE PRODUCTION RUNS
ALL FIXTURES, TOOLS, JIGS and DIES
MADE IN OUR MODERN TOOL ROOM
LET Us WORK OUT Your PROBLEMS
ALSO SPECIALIZED INJECTION
MOLDING OF SMALL PARTS, INTRICATE
INSULATING and INSERT WORK
Quotations submitted upon
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The Munising Paper Company

GENERAL SALES OFFICES • 135 SOUTH LASALLE STREET • CHICAGO, ILLINOIS

To the Plastics Industry

Gentlemen:

Various branches of the plastics industry have counseled with us concerning their impregnating paper requirements. Some have found our technical and manufacturing facilities most helpful.

We, ourselves, do not impregnate, believing our field is that of a basic supplier to your industry rather than a processor.

The Munising Paper Company has, however, developed a precision method of manufacturing bleached pulps and specialty papers that seems to be of interest in the laminating field. For example -

Pulp Manufacturing: Purification in the digesters is controlled to (plus or minus) 3.0% as measured by permanganate number. This assures a uniformity of pH controlled to the buyers specifications.

Bleaching: Variation in reflectivity is limited to (plus or minus) 0.4 millimicrons as recorded by the spectrophotometer. On translucent laminations variations in shade are correspondingly reduced.

Paper Manufacturing: Tolerances for weight, caliper, and absorbency (plus or minus) 2.5% both across the web and throughout the runs. Even absorption and level piling of sheets or winding of tubes result.

If this type of precision manufacture might prove helpful in your operations, may we suggest you contact us.

The Munising Paper Company

Pulp and Paper Mills:
Munising, Michigan

Executive offices:
135 South LaSalle Street
Chicago, Illinois

"Let us have faith that right makes might and in that faith let us dare to do our duty as we understand it."
— Abraham Lincoln.

Independence Day, 1943

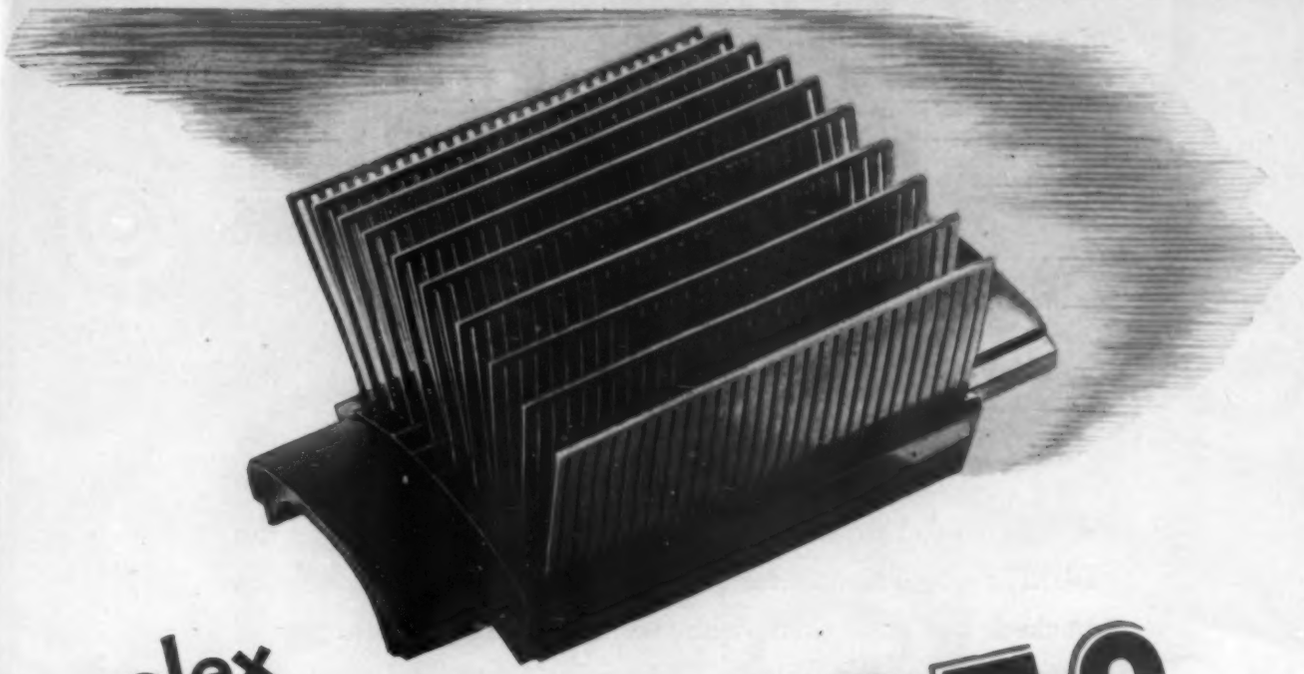
"I remember a Fourth of July night not so many years ago, when a little fellow said: '*Thanks for those swell fireworks, Pop.*'

"Today, I bought that boy more fireworks — real fireworks — by purchasing war bonds to help him blast the Axis into kingdom come. For he's a grown man now, and out there fighting for the right to have an Independence Day. So I'll buy him more fireworks today and every day, until he comes back home again. Why don't you do the same? Invest your dollars in war bonds!"

Rodgers Hydraulic Inc., St. Louis Park, Minneapolis, Minnesota. *Manufacturers of:* Universal Hydraulic Presses - Track Press Equipment - Hydraulic Keel Benders - Hydrostatic Test Units Power Track Wrenches - Hydraulic Plastic Presses - Portable Straightener for Pipe and Kellys

Rodgers HYDRAULIC Inc.

★ NUMBER 1 IN A SERIES OF *EDUCATIONAL* ADVERTISEMENTS ON TRANSFER MOLDING



Complex delicate INSERTS

precisely molded in without damage

TRANSFER MOLDING

is the best way to—

- Handle inserts—metal, glass, ceramic
- Mold high-impact materials
- Mold unsupported cores
- Achieve maximum dimensional accuracy
- Lower mold costs
- Lengthen mold life
- Increase molding speed
- Reduce finishing costs
- Get uniform cure regardless of cross-section
- Get practical solution to difficult molding problems

— on thermosetting plastics.

The two basic problems in molding inserts integrally into thermosetting materials are best solved by TRANSFER MOLDING. This process molds heat-hardening plastics around the most delicate materials, such as ceramics and glass, without damage. TRANSFER MOLDING also allows the insertion of the greatest number, most complicated arrangement and largest sizes of metal inserts. These inserts, used in assembly or function, are molded for the life of the pieces. They are molded in to exceedingly close tolerances. Rejects are practically eliminated.

TRANSFER MOLDING is defined as the "injection molding of heat-hardening plastics." It performs tasks which other techniques fail to accomplish.

TRANSFER MOLDING is an extremely economical and efficient process for producing plastic parts and pieces.

SHAW INSULATOR COMPANY

Irvington, SHAW New Jersey

DURITE

For Dependability

• You can always depend upon DURITE products and the DURITE organization for plastics of outstanding excellence backed by specialists who welcome the opportunity of according you the ultimate in friendly, intelligent service.

DURITE products being used in the production of Aircraft, Shell Caps, Tanks, Ships, Motorized Equipment, Electrical Equipment, Guns and many other Instruments of War testify to the versatility and dependability of DURITE plastics for exacting requirements.

Your inquiry regarding DURITE Molding Compounds, Adhesives, Bonding Agents, Laminating Materials, Cements, Coatings, Oil Soluble Resins and Synthetic Rubber Compounds will be welcomed. Our engineers are at your service on current production problems and post-war planning.

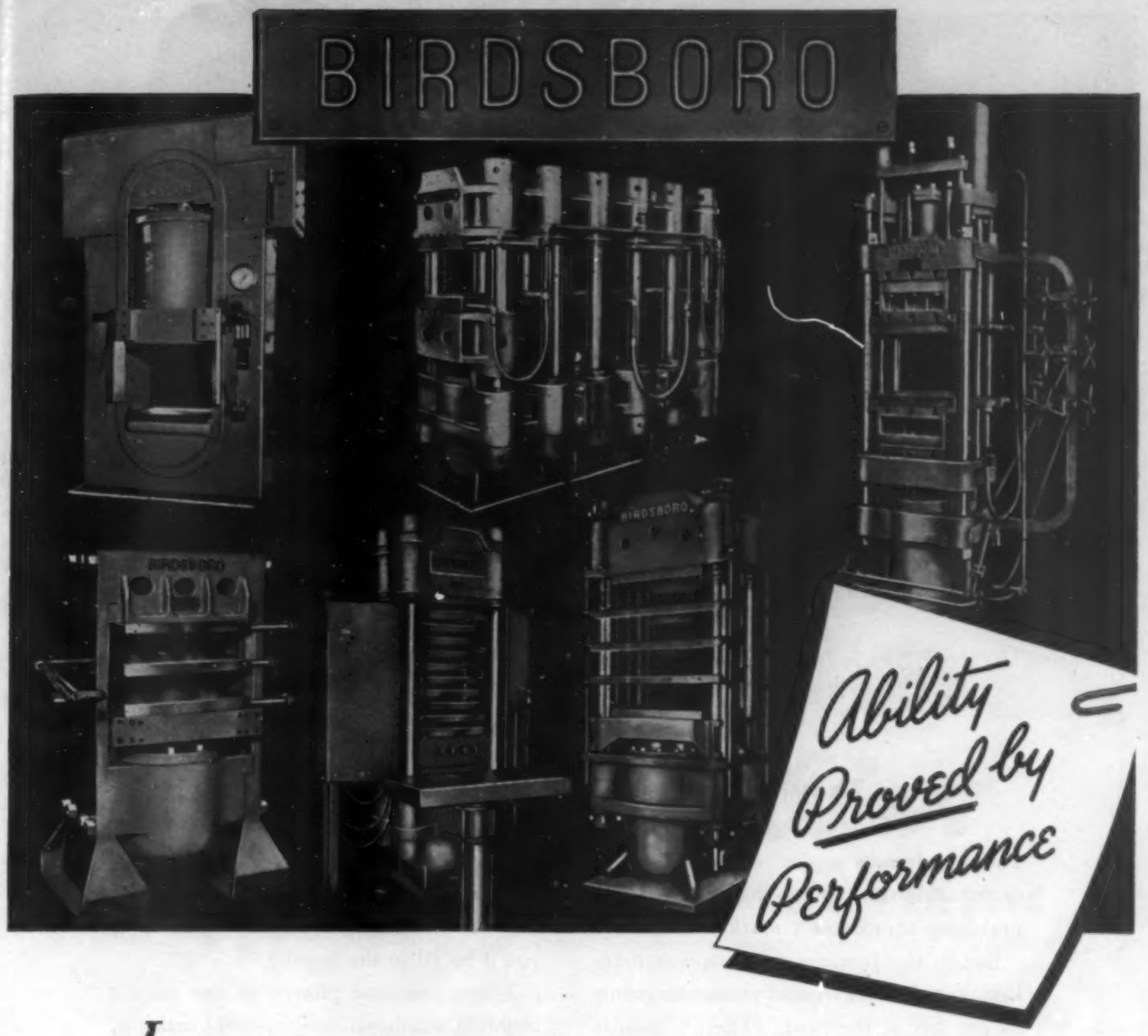
DURITE PLASTICS

REG. U. S. PATENT OFFICE

FRANKFORD STATION P. O. PHILADELPHIA, PA.

Synthetic Rubber Compounds

Phenol-Furfural Products *Phenol-Formaldehyde Products*



In plants from coast to coast, Birdsboro general molding presses and multiple platen sheet presses are passing the toughest performance tests with ease. Operation under actual plant conditions testifies to the minimum maintenance and maximum production standards set by Birdsboro Plastic Presses. If yours is a press problem, it pays to ask Birdsboro.

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PENNSYLVANIA

BIRDSBORO

HYDRAULIC PRESSES

They Can't Stop You From Dreaming!

Today's dreams — plus some down-to-earth slide-rule work—have a way of grabbing tomorrow's markets. Usually.

But in the jostling for post-war markets, some mighty good plans are going to get left at the post. (There's almost certainly going to be a bottle-neck in die-making, for instance!)

If your plans call for molded plastics, we've got a suggestion to eliminate that chance. *Let's get those dreams on paper—now.* Let's get our development engineers together with your design and engineering departments to work out tentative blue prints. Tentative, but definite enough to go into production (as is) unless later alterations become advisable. (Even so, you'll be all to the good.)

There are four phases to the plastic molding business: design, mold-making, molding and finishing. That makes this suggestion worth a 25% jump on the field!

We Offer *the largest, most complete plant facilities in the middle west, plus the services of development engineers with a national reputation. We're doing lots of war work. But we can talk about your postwar problems too!*

Plastics Progress, our FREE discussion of what's what in molded plastics, is published monthly. If you're interested in plastics, just ask (on your letterhead, please!) to be put on our mailing list —no obligation.

CHICAGO MOLDED PROD. CORP.

CHICAGO MOLDED PRODUCTS CORPORATION

Precision Plastic Molding

1046 North Kolmar Avenue • Chicago, Ill.

Compression, Injection and Transfer Molding of All Plastic Materials

JETTISON TANKS of Columbian

CO-RO-LITE PLASTIC

Snarling as they leap from a carrier's deck, Navy "Wildcats" prowl deep into enemy territory. Their radios are silent—must remain silent even if they are forced down by lack of fuel. And miles out—far over the horizon's rim—they may run into Zeros, may engage in a running dogfight that carries them leagues off their course.

That's why they carry Jettison Tanks of Columbian Co-Ro-Lite Plastic. Tanks that carry extra gasoline for the initial leg of the flight. Tanks that can be dropped if necessary at the first contact with the enemy, thus releasing the plane from the drag of the tanks and increasing its speed and maneuverability.

A Sisal-Filled Plastic

As strong as steel, as light as wood, Columbian Co-Ro-Lite Jettison Tanks are made from resin-impregnated sisal fibres. No essential metal is lost when they are dropped. They're simply another in the long list of Columbian Rope Company's contributions to the war effort—another instance where Columbian carries the fight to the enemy.

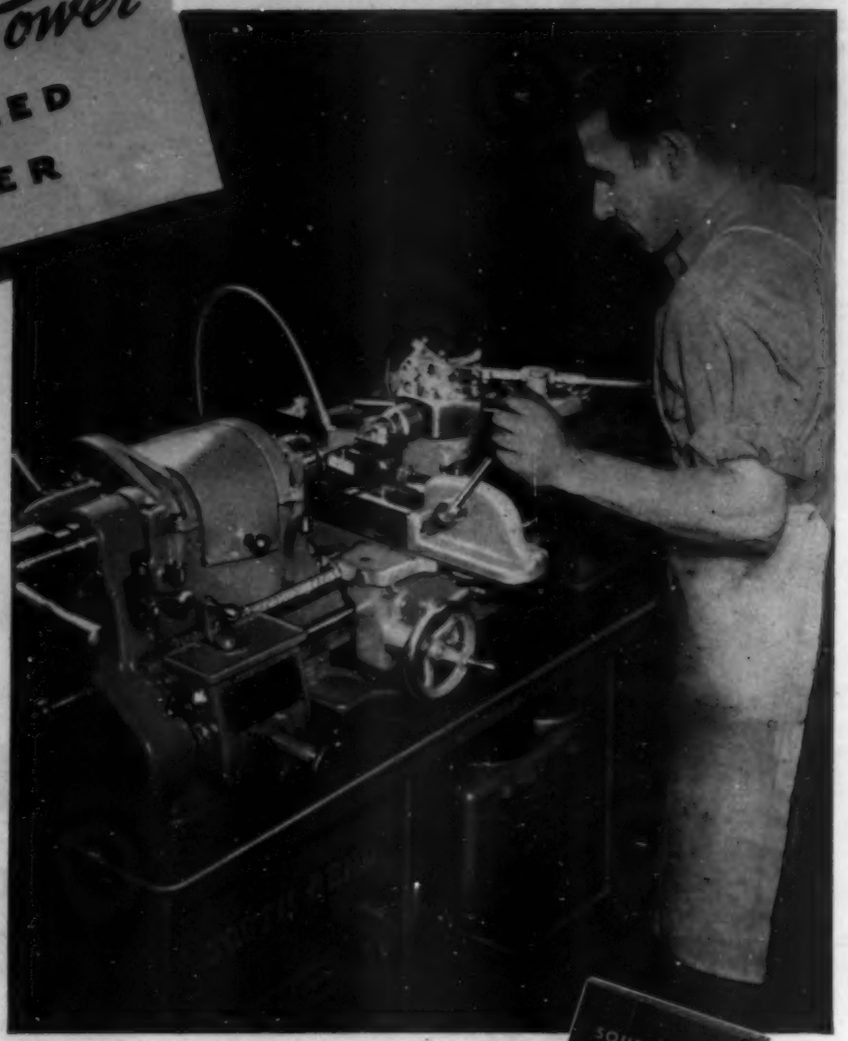
ALLIED PRODUCTS DIVISION

COLUMBIAN ROPE COMPANY

400-10 Genesee St., Auburn, "The Cordage City", N. Y.

Canadian Licensee: CANADIAN BRIDGE ENGINEERING COMPANY, LIMITED, Box 157, Walkerville, Ontario, Canada

MORE *Producing Power* FOR SKILLED MANPOWER



Skilled manpower is one of the most critical of all our strategic resources. To give our fighters the added striking power of more and better weapons, our skilled workers need the producing power of more efficient tools.

Machine tools that are inefficient because they are hard to operate, inaccurate, or incapable of delivering the required speeds are wasteful of critical manpower. Wasted manpower is lost production—and victory jeopardized!

Give your skilled manpower more producing power with South Bend Lathes. Designed and built to deliver maximum production with minimum effort, they are highly efficient on a wide variety of precision machine work. Their ease of operation reduces fatigue and seemingly shortens the workday by hours. This is accomplished through conveniently placed, smoothly operating controls—clear-cut, easy reading graduations—fully enclosed design with no exposed pulleys, belts, or gears—and dependable precision that permits top speed production, even when tolerances must be held to extremely close limits.

SOUTH BEND LATHE CATALOG

The entire line of South Bend Lathes is described in Catalog 100C. Write for your copy of this new 48 page catalog.

Army—Navy Production Award with Star presented to the South Bend Lathe Works for outstanding war production.

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 38 YEARS
SOUTH BEND, INDIANA

From the Drawing Boards of Sundberg and Ferar

"Productionally" practical today, yet reserved for tomorrow, is this all-plastic chair. New moulding techniques and new materials have made it possible for foresighted designers to create clear, transparent legs and back supports that give the illusion of sitting in space.

In addition to unique plastic beauty, comfort and utility have been designed into virtually every feature of this chair of the future. Large presses can mould the entire body of the chair, utilizing a new method requiring less pressure. Preformed sponge rubber cushion replaces steel springs . . . and tailored upholstery is woven extruded plastic.

This streamlined chair is simply an indication of thousands of plastic applications in furnishings, appliances and industrial equipment now on the drawing boards for post-war production. To help you plan *today* for your products of tomorrow, it will pay you to consult the Kurz-Kasch plastic engineers, tool makers and moulders . . . specialists in plastic design and production for more than a generation.

KURZ-KASCH

Planners and Molders for the Age of Plastics

Kurz-Kasch, Inc., 1417 South Broadway, Dayton, Ohio
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How to avoid FASTENER Problems

Use the National Screw & Manufacturing Company quality line of fastening devices. They are tailor-made to fit your needs.

There is no use saying that the best way to avoid fastener problems in plastics is not to use fasteners. A fastener of some type—screws, nuts, bolts or rivets—probably will always be needed in the industry.

Nor is there any use in saying that the National Screw & Manufacturing Company, makers of millions of successful fastening devices for 54 years, makes the best type of a fastener for every plastic fastening job. But—

If you need fasteners of any type, large or small, we may have them or we may be able to make them for you.

Write us about your problems. We'll give you the full benefit of our years of experience in headed and threaded products.

National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND, O.

Modern Plastics

JULY 1943 VOLUME 20 NUMBER 11

Engines have brains

The 18 cylinders of a powerful aircraft engine are controlled by a distributor housing molded of mineral-filled melamine

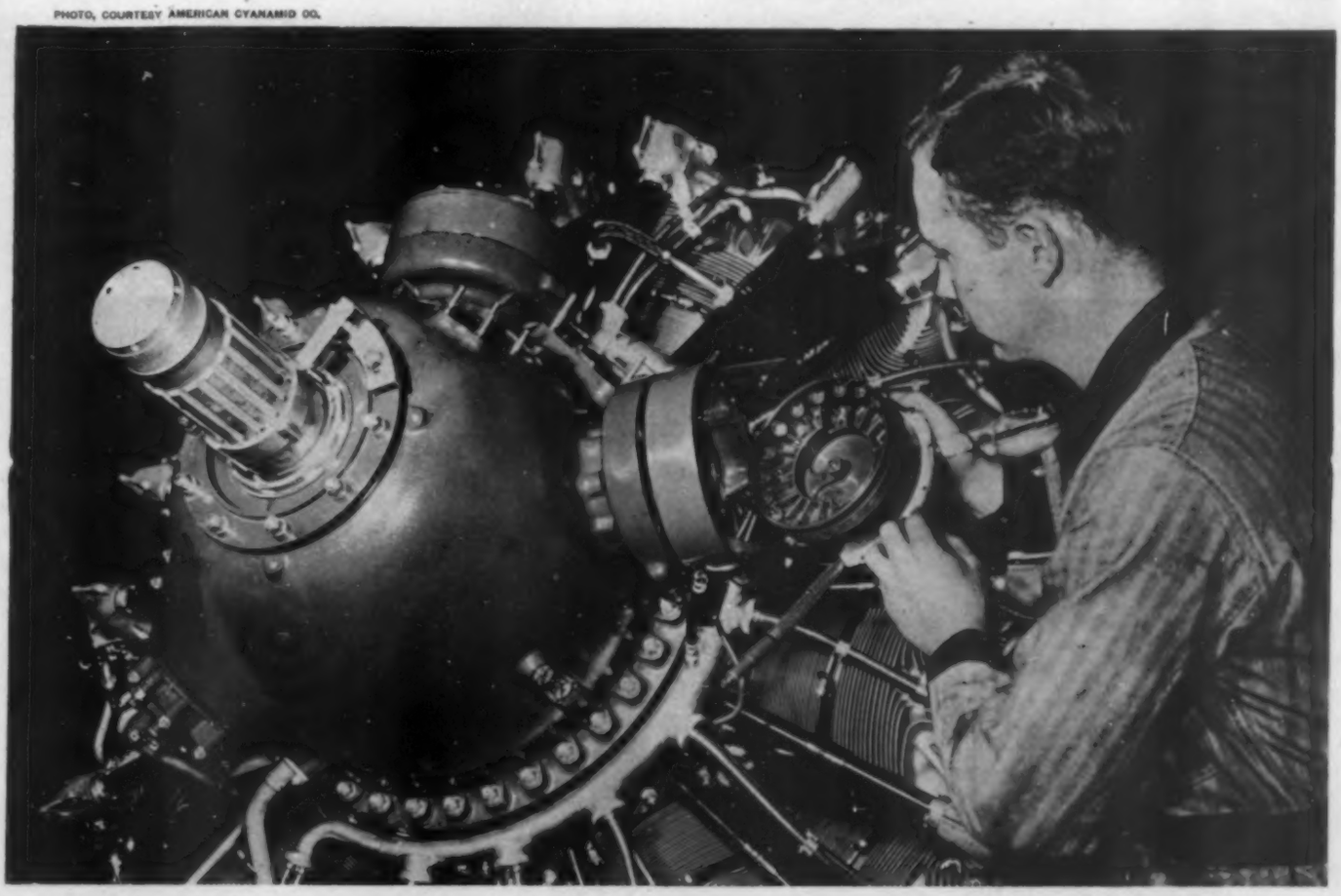
THE name of Ford is inextricably linked with soybean plastics, which Henry Ford personally developed and publicized as one notable application of his chemurgic theories. But the necessities of war production have led the company into many new plastics applications which employ some of the more conventional molding materials. In these applications, some notable new ideas have been contributed by company engineers.

Today, the section of the former tire plant at the Rouge works which is devoted to plastics production is humming with activity in extrusion, injection, compression and transfer molding. Scores of special dielectrical parts for Ford's own Pratt & Whitney aircraft motor are manufactured here. A battery of twenty 500-ton compression presses is operated by three shifts, 24 hours a day, handling some 2000 pounds of thermosetting material in the course of a full day's work.

The biggest, most complicated and most interesting of these dielectric moldings—and one which is typical of the company's development and technique—is the distributor housing which is the electrical "brain" for the 18 cylinders of the Pratt & Whitney radial aircraft engine. For this job, a mineral-filled melamine-formaldehyde thermosetting material was chosen, and the molding is believed to be one of the largest ever made of melamine.

Although Ford builds the Pratt & Whitney engine under license from that company and to their basic design, he has developed and suggested many improvements in materials and manufacturing technique, some of which have been adopted by the Army Air Forces as standard for all manufacturers of the motor. *(Please turn to next page)*

PHOTO, COURTESY AMERICAN CYANAMID CO.



ALL PHOTOS, COURTESY FORD MOTOR CO.

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The need for a better distributor head grew out of the fight for higher and higher altitudes in America's combat planes. It was found that in the rarefied air of the sub-stratosphere in which the best fighting planes now perform, arc resistance in electrical materials declined in proportion to decreased density of the atmosphere. Hard rubber which had previously been the conventional material for distributor heads showed a fatal tendency to carbon track and arc through, shorting the cylinders affected.

The engineers attacking this problem turned immediately to plastics, from which they had for years successfully molded automotive distributor heads. From this basis of experience they sought to develop higher dielectric capacity in both material and design. It was a comparatively simple matter, from a design standpoint, to increase electro-spacing of points to a maximum, but this set up heavy demands on the material. It was soon apparent that none of the more familiar plastics would fill the bill.

Among the scores of materials tested, three were outstanding: mineral-filled melamine-formaldehyde molding material, mineral-filled phenol-formaldehyde molding material and a soybean compound. The latter two gave good results in dielectric strength and in arc resistance, but for this particular use were found somewhat lacking in moldability. The best combination of the three desired characteristics was found in a melamine formula which provided dielectric strength of 430 volts per mil, arc resistance average (A.S.-T.M.) of 130 sec. and heat resistance of 300° F.

The molding job was complex, both because of the intricacy of the mold and inserts and because the structure of the finished material and the spacing of the many contact points must be perfect to give proper dielectric performance.

1—In lower half of open distributor head mold, 26 metal inserts are painstakingly set in position. 2—At the same time, core pin assembly is locked into upper half, which forms the head's outside surface. 3—On the roller conveyor, two mold halves are mated and move on to the press. 4—Cans of mineral-filled melamine, 5 at a time, are attached to a revolving axis in the center of a drum which serves as an oven. Infrared lamps around oven's circumference heat powder uniformly to a temperature of 200° to 220° F. 5—Preheated melamine is poured into the cylinder and mold locked in place in the press, with plunger in position. 6—Inside of head after mold has emerged from curing press. 7—Heads are cooled in bins of sawdust. 8—In turret lathe, head is shaved and electrodes cut down

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The 18 cylinders of the Pratt & Whitney require 26 metal inserts, as against 9 inserts called for by the biggest automotive distributor housing formerly molded in the plant.

Because of the intricacy of the inserts to be used with an extremely high-pressure material, it was found impractical to use the conventional compression molding methods. Transfer molding, never before attempted in the plant, permitted the proper pressure control and mold resistance. Standard compression presses were readily adapted to the transfer molds and operators were trained in the unfamiliar and special technique.

At this point, the problems originally attacked had been solved. But it developed that higher pressure molding accentuated a difficulty previously noted in molding the part: that the thin, L-shaped metal inserts, formed of three pieces of brass and silver soldered together, had a tendency to break down in the mold, causing the rejection of the entire part when it came to the final dielectric inspection test. This led to what is perhaps the outstanding change in the part. Inserts are now made of Monel metal, cold forged in one piece by a process developed in the engineering laboratories, and breakdowns have been virtually eliminated. Manufacture is simple, and the inserts are turned out in high volume by a Detroit stamping company. Here again, a problem was licked by drawing on previous automotive experience, the idea having been suggested by use of similar forged brass inserts in automotive distributor heads.

Many thousands of the improved plastic heads have already been manufactured by the company, and not only incorporated in all Pratt & Whitneys assembled by Ford but also sent out to all world battlefronts to replace the inferior rubber heads. Thus has a plastic development raised the ceiling for American fighting planes and lifted the United Nations a notch nearer to victory.

Along with the development of the head, the company's engineers have designed a new finger, or rotor, which whirls inside the head and distributes the electrical current to the 18 contact points in the head, connected by wires to the spark plugs in the 18 cylinders. By increasing the distance between electrodes in the rotor, the dielectric strength in the new design is increased 300 percent. This part also is molded of melamine-formaldehyde.

Throughout the development of these two complementary pieces, the problem was complicated by the fact that the

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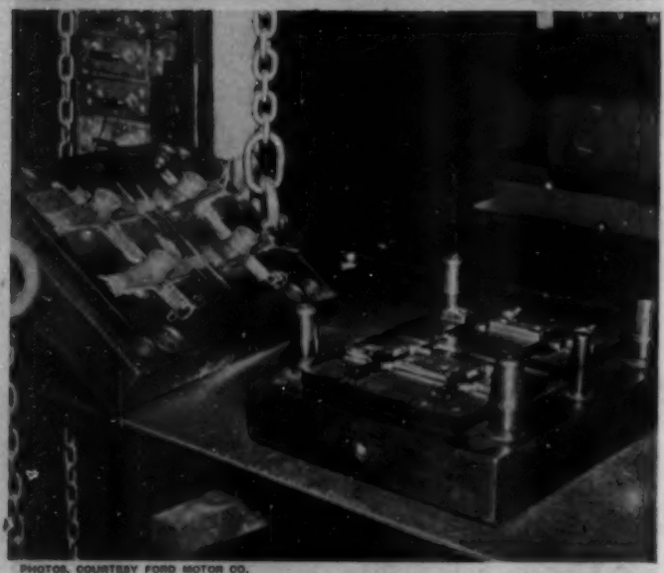

11

PHOTOS, COURTESY FORD MOTOR CO.

9—Heads are checked at the inspection bench, numbered markers inserted. Heads piled at left show holes where ignition wire plugs are inserted. **10**—*Finished distributor head, transfer molded of mineral-filled melamine.* **11**—*Distributor rotor 4-cavity transfer mold, here taken apart after molding and curing*

parts had to be kept perfectly interchangeable with the older type. Although the Ford finger and rotor can be used only with each other, together the two parts are interchangeable with similar ones previously in service.

The production process, handled throughout with time- and labor-saving efficiency, starts with the ticklish hand job of fitting the 26 cold forged metal inserts into place in the open lower half of the mold (Fig. 1). These one-piece forged inserts, several of which are shown at the side of the mold, have much less tendency to fail in the mold than the former type made up of three pieces of brass and silver soldered together. At another station nearby, a workman is inserting and locking into place in the upper half of the mold the core-pin assembly, holding 19 pins of varying lengths (Fig. 2). Ignition wires which carry the spark to the 18 cylinders of the 2000-horsepower aircraft motor will fit in the holes formed by these core pins.

The lower half of the mold passes down a roller conveyor and meets the assembled upper portion, which is lifted by an air hoist and then lowered to mate with the lower half (Fig. 3). The mold (incidentally, the first transfer mold ever used by the company and specially developed by its engineers) is then ready for the press, and moves farther along the roller conveyor to the press for which it is destined.

Meanwhile, the melamine powder charge has been heating, and for this purpose, an efficient and unusual method was devised. For a heater, an ordinary industrial tumbler, or round drum, about 4 ft. in diameter was taken and a battery of infrared bulbs installed in its outer circumference (Fig. 4). This leaves in the center a round oven approximately 2 ft. in diameter. A revolving axis is fitted in the center of the oven, and to this are attached, five at a time, the special cans each containing a carefully pre-weighed charge of the melamine molding powder. Access is through a round door at one end of the drum.

The virtue of this device is that it permits quicker and more uniform heating of the powder charge, both because of the infrared heating unit completely encircling the oven, and because as the axis revolves the powder is constantly agitated and shifted inside the cans. In 15 minutes the powder in the five cans is heated to the required temperature of 200° to 220° F. with complete uniformity.

Removed from the heater, the can of powder is taken a few steps to the waiting mold on the conveyor, and within a matter of seconds is poured into the cylinder which in the meantime has been attached to the mold. The entire mold assembly is then lifted directly into the press (Fig. 5).

Although 500 tons of pressure is available in the presses, only from 200 to 300 tons is used in this operation, the pressure varying according to the analysis of the molding powder, which is somewhat variable. Molding temperature is 270° to 290° F., and the press cycle is 11 minutes. Molds are preheated at the start of a run, and are found to lose little temperature in the rapid stripping, reassembly and turn-around back to the press.

From the compression press, the mold goes to a curing press, where it is held 10 minutes at 300° F. It is then pulled back to the roller conveyor and passed down to the end (Fig. 6) where the mold is stripped in a small hydraulic press. Parts of the mold are cleaned manually and by compressed air, and reassembly for the next molding starts immediately.

As the distributor head comes from the mold it is assembled on a shrink plug, placed in a bin and completely covered with sawdust for slow and uniform cooling (Fig. 7). Careful cooling is essential to successful (*Please turn to page 138*)

A handful of power

A REVOLUTION is taking place in machine and tool design. Production schedules in war plants demand maximum, uninterrupted employment of men, materials and tools. But the women and older men who today comprise a large part of our work force have slight knowledge of machine tools. They possess neither the training nor the energy of the young, able-bodied men now in the Armed Services who formerly kept the machines humming.

As a result, a demand has arisen for simplified machine tools that require little or no maintenance, are light and easy to operate and provide some protection against injury; and tool engineers have been presented with the problem of redesigning their tools to meet these requirements. The scarcity of raw materials further complicates the problem, putting a premium on long wear and metal replacement.

Newest of these redesigned tools is an electric hand drill, a thermoplastic-housed model weighing $3^1/_4$ pounds. It is said to be more than 14 percent lighter than the aluminum-cased unit it replaced. This weight differential is an important consideration. Over a long period, drill operators build up considerable fatigue, and a few ounces taken from their tools can make a great difference by the end of a day.

The radical change in the construction of this tool is the method of mounting all internal mechanical parts, bearings, gears, stator and centerplate in a "skeleton frame." This sturdy inner metal framework forms an independent, self-contained unit, assuring close tolerances and the permanent alignment of all moving and stationary parts. The plastic housing slips over this skeleton frame as a sort of armor, affording protection to the operating parts.

In the past, electric drills were built with the motor and other operating parts supported by the exterior housing This resulted in the stresses being transferred to the aluminum outer casings, and made wall reinforcement necessary to preserve rigidity. This building up of the housing markedly increased the weight of the drill. But in the new design, where the plastic casing is used only as a protective armor, the housings can be lightened with thin wall sections, making possible a better balance for the tool and throwing less strain on the operator's wrist (see Fig. 2).

Injection molded of cellulose acetate butyrate, the drill housing is attractively designed and constructed to take maximum advantage of the plastic material. There are 5 plastic parts to this unit: a field case (A in Fig. 1), gear case (B), handle (C), trigger (D) and handle cover (E). While the tool is manufactured with 3 speeds (2500, 3750 and 5000 r.p.m.), all cover parts are the same except in the case of the gear housing. This piece changes in size with each model.

These casings simply slide into position over the metal "frame." The field case is slipped over the motor from the handle end and held in a keyed position against the metal centerplate, an integral part of the base frame but seeming to encircle the drill body (above). The grip handle locks the field case in place and is itself attached directly to the metal framework by screws. The gear case is locked against the centerplate and held in position with a metal protection nut threaded directly to the metal frame. To disassemble for servicing, only 2 screws and a nut need be removed.

Considerable heat is generated when these tools are in operation. While the non-conductive qualities of the cellulose acetate butyrate (1.7 Btu. per hr. per sq. ft. per ° F. per in.) protect the operator's (*Please turn to page 132*)

1—The five molded parts of the plastic drill housing: A, field case; B, gear case; C, handle; D, trigger; and E, handle cover. 2—The newly designed "skeleton frame" permits a lightening of the plastic housing and results in a better balanced tool which throws less strain on the operator's wrist

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ALL PHOTOS, COURTESY INDEPENDENT PNEUMATIC TOOL CO.

John Wesley Hyatt Award for 1942

FOR distinguished contribution to the plastics industry during the year 1942, the John Wesley Hyatt Award was conferred upon Frank Henry Shaw, president of Shaw Insulator Co., Irvington, N. J., at a dinner held at the Waldorf Astoria Hotel, New York City, on the evening of June seventeenth.

FRANK H. SHAW

Mr. Shaw's development of the transfer molding of thermosetting materials, particularly as applied to production for war, was the basis for his choice by the Award Committee. By subjecting thermosetting material to heat and pressure and then "transferring" it in a plastic state from pressure pot to closed mold cavity, it is now possible to produce numerous delicate and complicated moldings, among them magneto housings for high-altitude aircraft, firing pins, shell fuzes, gun stocks and complex electrical parts for Army and Navy use.

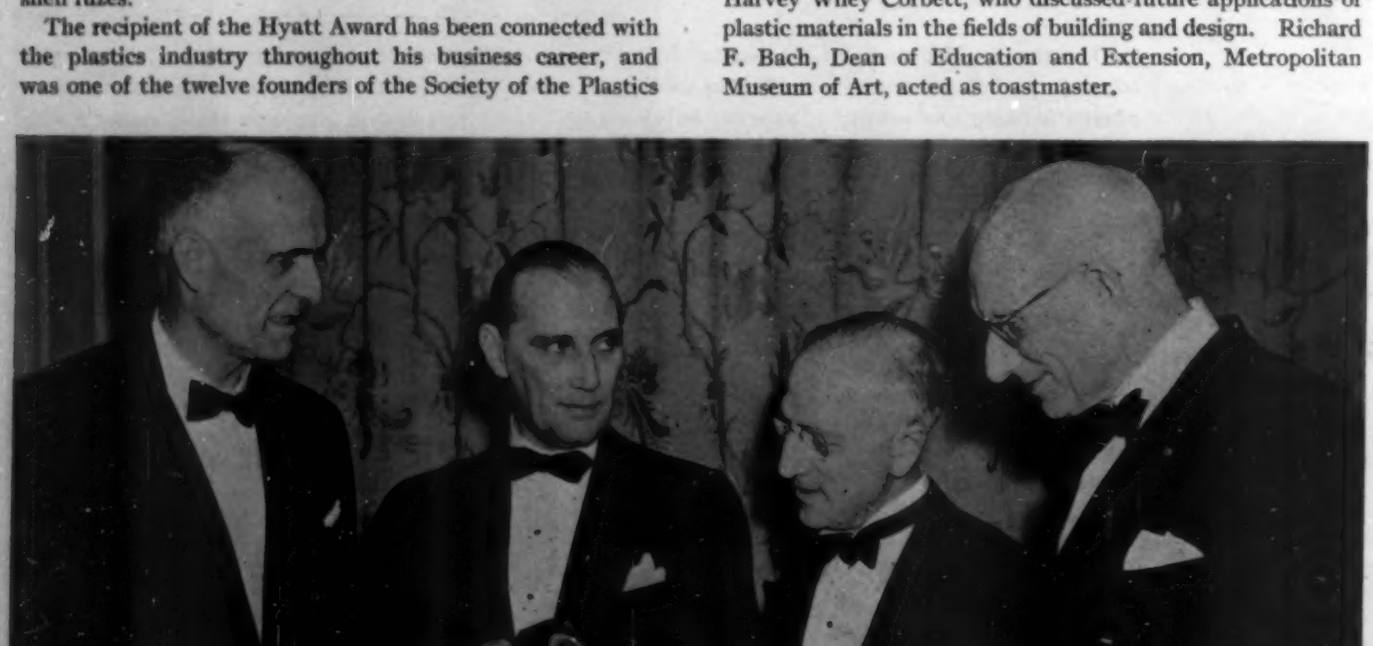
Pieces molded by the transfer method are characterized by extremely close tolerances, thin wall sections and the incorporation of a variety of intricate metal inserts. The development of transfer molding has enabled plastics to be selected for complicated parts called for by the armament program which could not have been molded to specifications by any other means, and thereby has considerably widened the field of plastics applications. The Ordnance Department recently recognized the worth of transfer molding to the war program by citing Mr. Shaw for his saving of aluminum through the use of transfer molded plastics for mortar shell fuzes.

The recipient of the Hyatt Award has been connected with the plastics industry throughout his business career, and was one of the twelve founders of the Society of the Plastics Industry. Born and educated in New Jersey, he entered the company he now heads when his father Henry M. Shaw, was its president. In 1936, after serving as vice-president and general manager, he succeeded his father in the presidency.

Mr. Shaw's achievements with transfer molding serve to call attention to the degree of selflessness which has characterized the growth of the plastics industry during the past 35 years. Men have been willing to gamble time, money and reputations on new experiments which in many cases brought no profitable results. He himself developed the first plastic radio tube base, made many modifications of radio tubes and sockets, and during and after World War I was responsible for much of the design of molded insulation for Signal Corps apparatus—not in exchange for fat fees and valuable contracts, but in the imaginative pioneering spirit which serves as an inspiration for the industry.

Mr. Shaw is the second to receive the John Wesley Hyatt Award, consisting of a gold medal and one thousand dollars, which was established in 1941 by Hercules Powder Co. in honor of the inventor of Celluloid, the first plastic composition. The Award was presented by Dr. Per K. Frolich, president of the American Chemical Society, who paid tribute to the keen perception and native intelligence of John Wesley Hyatt—a true industrial pioneer.

Guest speaker of the evening was the well-known architect Harvey Wiley Corbett, who discussed future applications of plastic materials in the fields of building and design. Richard F. Bach, Dean of Education and Extension, Metropolitan Museum of Art, acted as toastmaster.



DR. PER K. FROLICH, FRANK H. SHAW, HARVEY WILEY CORBETT RICHARD F. BACH

1—*This giant Curtiss Commando (C-46), world's largest twin-engined airliner, pictured with an escorting Warhawk fighter, employs four all-plastic antenna masts*

PHOTO, COURTESY CURTISS-WRIGHT CORP.

Transport plane mast

For antenna masts as for other airplane parts where light weight and maximum strength are desired, experience has dictated the choice of plastic materials

A SERVICE man, flown home from India, was asked if he was happy to be back in his native land. "Everything's swell," he said, "except that I didn't have time to pick up my laundry before I left India—and now I'll have to wait for it until *next week!*"

Perhaps that's just another good old Army gag, but current news dispatches report that wounded men have been transported by air from India in five days and, in fact, the giant new twin-engined military transport plane, the Curtiss Commando, is said to have flown the 15,000 miles in $4^1/_2$ days. These long sky troopship flights not only give concrete evidence of America's resolve to speed matériel and men to critical points in the widely scattered battlezones of the United Nations; they also point toward the day when our present domestic airliners will be dwarfed by such huge flying freighters.

Originally designed as a luxury liner, the Curtiss Commando (C-46) has a wing span of 108 ft., is powered by two 2000-hp. radial engines and weighs approximately 50,000 lb. fully loaded. In order that as many men and as much equipment as possible may be carried, the engineers who planned the ship tried to eliminate every ounce of superfluous weight in the plane itself. Where light weight combined with maximum strength was desired, previous experience with other Curtiss planes dictated the choice of plastic materials. Outstanding among such applications is an all-plastic, one-piece molded mast, four of which are used on each ship—three as antenna supports and one which serves the dual purpose of supporting the antenna and holding the pitot tube.[1]

Developed to provide the strength necessary to withstand the air pressures encountered in flight, the Curtiss mast is quite different from the large, two-piece molded-laminated mast,[2] and small thermoplastic unit[3] which several years ago indicated that plastics were adaptable for this purpose. The mast is molded entirely of a special cloth, impregnated with a phenolic resin and then creped (contracted in both diagonals) so that it will stretch in all directions.[4]

Unlike the conventional laminating cloth which is intended for flat surfaces, this creped cloth permits the forming of molded objects with compound shapes which retain the high strength of continuous laminations, since the all-directional stretchability allows the cloth to flow along with the resin under heat and pressure within the confines of the mold. The material's flow or draw is merely an unfolding of the gatherings or crepes which does not distort the fibrous structures. The contour of the mast, with its flared base, tapering inside diameter and outer flanges to which antenna

[1] This is a tube with a short right-angled bend, placed in a moving body of fluid so the flow passes the tube horizontally, to measure the velocity of the fluid. In aeronautical applications such as this, the pitot tube is combined with the static tube which forms a pressure nozzle, and is used in connection with a manometer to determine the relative speed of air or impact of air against the plane.

[2] MODERN PLASTICS *19*, 134 (Nov. 1941).

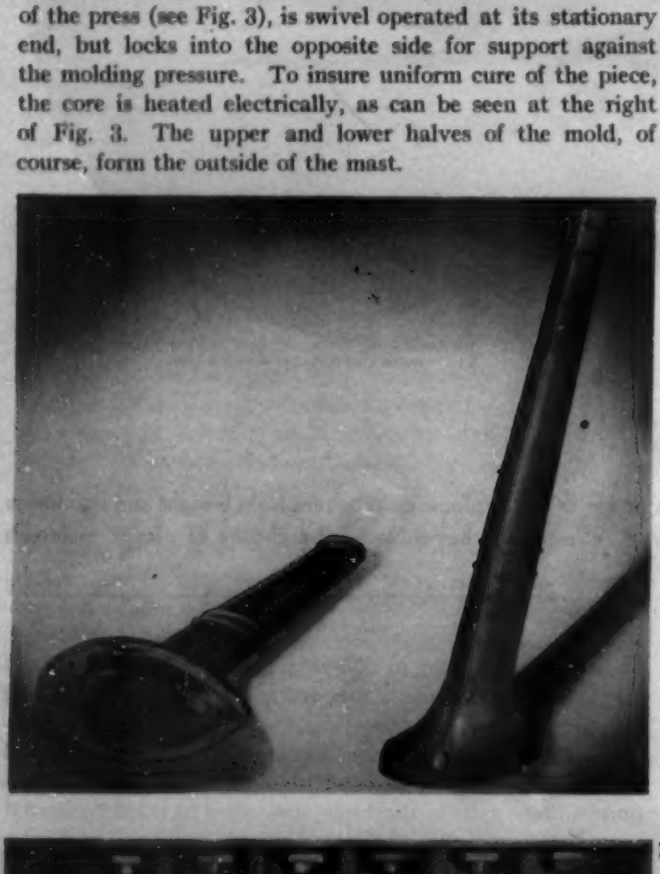
[3] MODERN PLASTICS *19*, 39 ff. (Mar. 1942).

[4] "Molding Resin-treated Paper," MODERN PLASTICS *18*, 39 ff. (Mar. 1941).

wires are fastened, demanded these conditions of moldability plus great strength (see Fig. 2).

The mast which stands 20½ in. high with a base 7½ × 4¼ in., is built up of layers of the resin-creped material, die cut to the approximate shape of the finished piece. Shorter pieces of the material are interleaved among the strips that form the base to provide a thicker wall section. The same phenolic cloth fabric in flaked form is added to the load in the mold to build up the wall section at the top of the mast. Weight of the total charge is 760 grams. Exactly half of the material used is placed directly into the lower half of the mold (Fig. 3). Then a center core (described below) is lowered and the balance of the strips loaded on top of the core before the mold is closed.

The one-piece construction is achieved by a unique mold set-up which employs a movable steel core to produce the hollow center of the mast. The core, fastened to one end of the press (see Fig. 3), is swivel operated at its stationary end, but locks into the opposite side for support against the molding pressure. To insure uniform cure of the piece, the core is heated electrically, as can be seen at the right of Fig. 3. The upper and lower halves of the mold, of course, form the outside of the mast.



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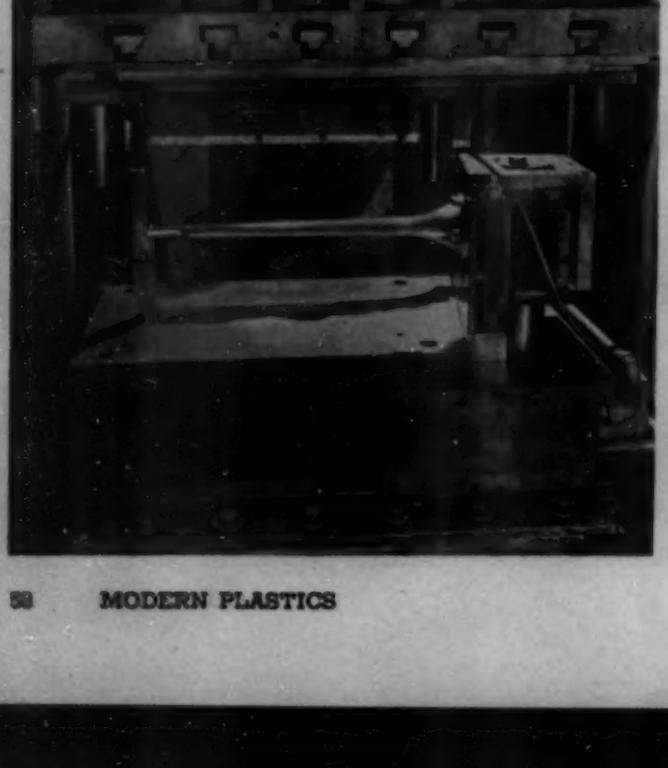

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Each mast is produced in a 9½-min. cycle, but for one-half minute of this time the mold is allowed to breathe before it is tightly closed. A 500-ton press is required because of the size of the piece, but molding pressure is only 250 tons.

After molding, the steel core is swung out and the mast easily removed by pulling it off the core (Fig. 4). An excellent finish is obtained because the material permits itself to be pinched off around the edges, thus giving molded edges instead of the cut edges prevalent in most laminates. Very little actual finishing is required except sanding the fins and drilling the mounting holes in the base. The smooth surface is excellent for the gray lacquer which is painted on to blend with the camouflage on the rest of the plane.

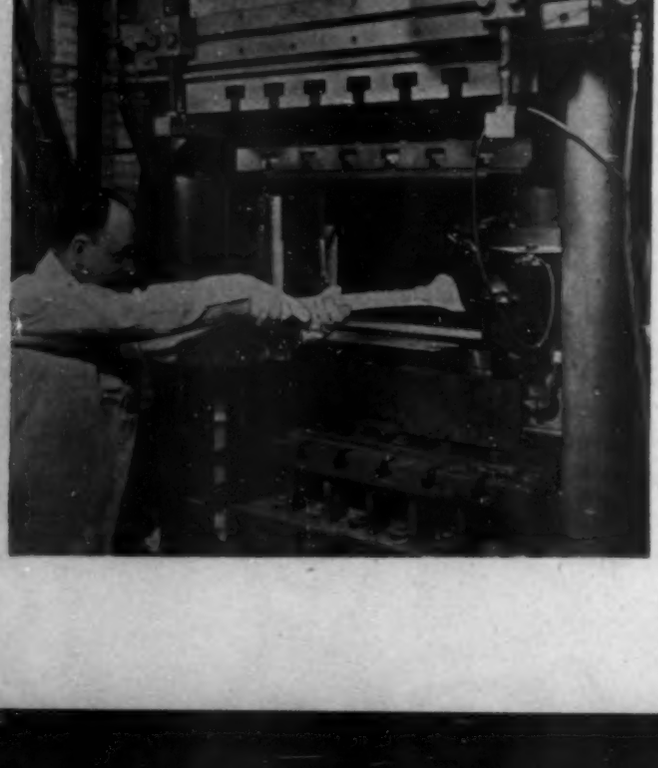
The one-piece construction of the mast helps simplify and speed the molding process, eliminates the need for assembly operations and long hours of machining and improves the strength-weight ratio—so vital in aircraft design where engineers battle over the addition of a fraction of an ounce of weight. The plastic mast weighs only 1.65 lb. stripped; weight of forward mast, which supports the pitot tube assembly weighing an additional 1.00 lb., totals 2.65 pounds.

The Curtiss-Wright Corp. reports that the molded mast is exceptionally satisfactory not only in its strength-weight factor, but also in its resistance to moisture and to the extremes of temperature encountered under flight conditions. Because of this, the company has arranged to make this plastic molded mast available to other aircraft manufacturers in the United States.

Credits—Material: Cloth Resin X-Crepe, developed by Cincinnati Industries, Inc. Molder: Chicago Molded Products Corp. for Curtiss-Wright Corp., Airplane Div.

***2**—Two views of the antenna mast showing flaring base and series of outer flanges to which antenna wires are fastened. Mast at left gives glimpse of tapering inside diameter.* ***3**—With lower half of mold filled with resin-creped material, the steel core fastened at one end of the press for swivel operation, is lowered and locked into place, and the remaining strips of material loaded on top. Electrical wires at right heat core and insure uniform curing.* ***4**—Here the completed mast is being pulled from the core which has been swung out from the mold*

PHOTOS, COURTESY CHICAGO MOLDED PRODUCTS CORP.



Seeing through turbines

ON December 8, 1941, the United States emerged with a jolt from an era of abundance. Suddenly there was not enough of the raw materials needed by a country at war. The power field, like many others, had for several years been expanding rapidly, but by 1941 delivery of such items as turbines was as much as two years behind order date. Yet booming war production admitted of no delay in the delivery of electric current.

A partial solution for the threatened shortage was improved operation of units already in service. In line with this trend, the Laboratories of the U. S. Bureau of Reclamation have sought to extend the study of hydraulics by the fabrication of a transparent model of one of the Boulder Dam turbines (Fig. 2), units which are rated at 82,500 kilowatts. Acrylic sheet was decided upon for this application because of the ease with which it adapts itself to sawing, shaping, drilling and cementing in the laboratory and because visual observation of flow conditions is vitally important in this field of study. The transparency of the plastic material has the added advantage of permitting motion pictures to be taken of the miniature turbine's functioning and run off later in slow motion for observation and study.

The completed model (Fig. 1), which will be used as an exhibit at Boulder Dam when all studies have been completed at the Laboratories, required approximately 3600 man-hours for its blueprinting and fabrication. First it was necessary to draft prototype dimensions to model scale (1 to 20), reducing to man size one of the turbines that helped generate 3,220,000,000 kw-hrs. in 1942. Construction details had to be modified to suit the use of the plastic material. Wood, plaster and steel molds were made for forming the sheets of plastic to the desired shapes. Softened in suitable ovens, the acrylate sheets were molded to the necessary shapes, and these shapes trimmed and machined. Other parts of the model were machined from the transparent plastic. The plastic parts were then cemented together with ethylene dichloride and the component parts of the entire model bolted and screwed into the final unit. All that remained to be done was a final polishing and buffing.

The large parts of the model—that is, the scroll case, draft tube and shroud for the turbine runner—were shaped in forms from .100-in., .220-in. and .250-in. polished acrylic sheet. The same sized sheets were used in molding the wicket gates and guide vanes in steel molds. Such intricate working parts as the wicket gate arms, speed ring and butterfly valve were machined from .750-in. and 1.500-in. unpolished acrylic sheet. In the entire model the only metal part of consequence is the turbine runner which was cast from Babbitt metal.

Credits—Material: Plexiglas, supplied by Plastic Products Co. Fabricated at the Laboratories of the U. S. Bureau of Reclamation

PHOTOS, COURTESY PLASTIC PRODUCTS CO.

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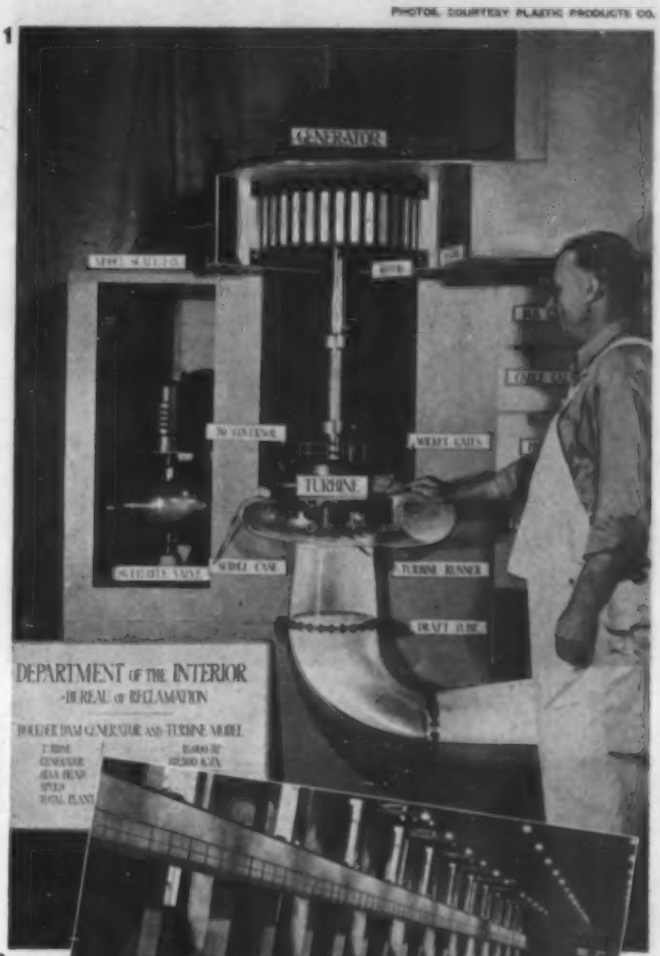

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1—*Elmer Olsen, builder, beside model turbine he constructed of transparent acrylics.* **2**—*Row of generators in a power house on Nevada side of Boulder Dam. Turbines are below floor level. The man in right foreground looks like a pigmy in comparison.* **3**—*Intricate working parts of model are molded or machined of transparent acrylic*

Half a shave

A difference in weight of 3 oz. can be of supreme importance to a soldier toting a 30-lb. pack over 25 miles of rough ground. A new collapsible plastic razor and case weighs that much less than a standard model and is less than half its size, although the extended handle hardly falls short of its predecessor.

The handle is molded in two sections of cellulose acetate of a high acetyl type which withstands a severe Army boiling water test and has good mechanical strength and wear resistance. A 12-cavity die molds 6 complete handles in one operation. In the smaller or top half of the handle, metal inserts can be used. This section is dropped through the tapering, hollow, bottom tube after molding, whereupon the large end of the ouside tube is sealed with a disk stamped from cellulose acetate sheet. The joint is rubbed and finished to give the appearance of one piece. The smaller or top half of the handle is held in extended position for shaving by the Morris taper design of the two sections. The Government specifies that the cap and razor guard be molded of phenolic resin, although for less exacting specifications a serviceable razor can be molded with a butyrate cap and guard. Twelve-cavity molds are used for caps and guards. The box with its removable mirror is molded of cellulose acetate, 4 containers being produced simultaneously.

Credits—Razor molded by Dillon-Beck Mfg. Co. Box molded by Arpin Products. Distributed by Federal Razor Blade Co.

PRODUCT

Ten little grommets

In almost every piece of war equipment that flies, floats or travels on land are a multitude of small plastic parts doing their bit to stretch the nation's stockpile of natural rubber. Typical of these rubber replacements are plastic grommets—little collars used to line apertures for the passage of wires and cables to prevent cutting or chafing, or employed as vibration-absorbing bumpers.

Speed of production, cheapness, strength, resiliency and precise dimensions are the qualities demanded. A company producing these parts in large numbers has found that grommets molded of black vinyl resin are superior to the original rubber parts chiefly because of the speed with which they can be produced: injection molded in 10-cavity combination molds in a 20-sec. cycle, whereas rubber grommets must be molded individually. A typical mold produces 10 grommets in 4 sizes—3, 3, 3 and 1, as shown at the right. An ingenious shifting of plates and pins permits the manufacture of from 550 to 600 different sizes and shapes of grommets in a single adjustable mold. As the mold unloads, the vinyl grommets are completely cured while an additional 10 or 15 min. must be allowed when making rubber grommets. Sprues are snipped off by the press operator, and the parts are ready for shipment. All scrap is remolded.

Tests show the tensile strength of the finished grommets to be 1000 p.s.i., with a satisfactory flexing quality within a range of +180° F. to −40° F. The abrasion loss ratio

is only $1^1/_2$ to 1 when compared with fine rubber tire stock. Continued experiment and mass production have resulted in cost of the grommets being cut in half.

Credits—Material: Vinylite, mixed by Ditzler Color Co. Molded by Bay Mfg. Div., Electric Auto-Lite Co.

Inspection hole cover

Time and space—these are the elements that turn the tides of war. Faced with the need of moving ever more troops and equipment to our many fronts, the Army has stripped its aircraft down to the bare essentials and constantly is on the lookout for new ways of reducing construction weight and speeding production.

A new inspection hole cover to permit checking of interior cables and other equipment is injection molded of strong, weather-resistant cellulose acetate butyrate in a multi-cavity mold at the rate of 4 shots per minute. Designed primarily for use on Army transport gliders, but applicable to most fabric-covered or plywood ships, it offers many advantages over the old 20-piece metal assembly. In addition to being lighter in weight and quicker to produce, this inspection hole cover is streamlined to reduce drag, is low both in manufacturing and installation costs and can be furnished in any color. When the cover is molded of transparent materials, inspection can be made without removing it.

The unit consists of a molded outer retaining ring and a center cover disk. The outer ring has three bayonet projections molded into the inner perimeter which coincide with the three entrance notches in the locking grooves of the center cover, so designed as to permit double locking and thus guard against the cover's coming loose in flight. This cover can be removed by turning 120° counter clockwise and inserted by turning 120° clockwise. Indicating points are cast into the faces of both pieces and two small depressions are molded into the cover to give finger grip. When installed in the plane assembly, the outer ring is doped to the surface, the inspection hole cut in the fabric with a sharp knife.

Credits—Material: Tenite II. Molded by Ford Motor Co.

DEVELOPMENT

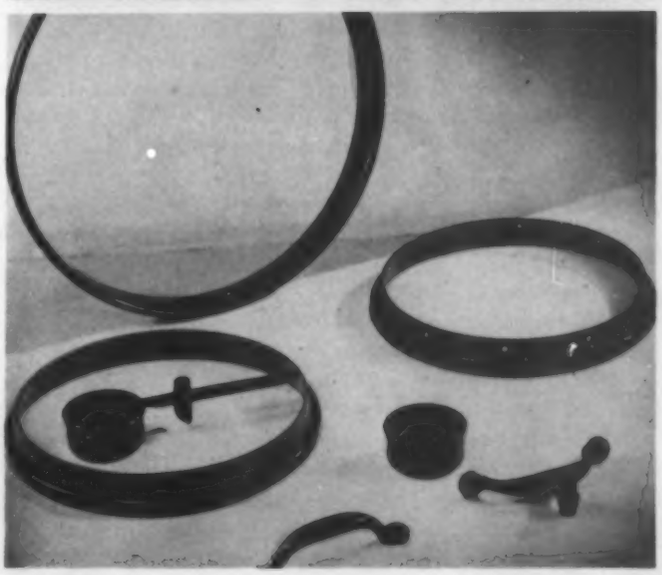
Navy megaphone

Success or failure of communications can decide a battle or a war. Part of the responsibility for the collapse of the French Army has been attributed to the failure of instructions to reach the front. In the Navy, one unheard order can mean a shipload of Lend-Lease supplies lost to our Allies or the escape of a Nazi submarine from the trap laid for it. In consequence, much reliance is placed upon intraship telephone systems. But there are purposes for which this apparatus is not fitted and conditions which preclude its use. Then it is to megaphones that the Navy turns.

These Navy megaphones of necessity receive rough handling, because the officer who has just hollered through one cannot always take time to deposit it gently on the sidelines out of harm's way. To withstand the knocks and jolts, a sturdy material was needed for the exposed bottom edges, the mouthpiece and the protruding handle, parts subject to greatest abuse. For these three pieces, the new megaphones employ mechanically strong, wear-resistant, black cellulose acetate.

These megaphones are produced in 2 sizes, necessitating 2 different sets of base and mouthpiece dies, but the same handle is used on both units. The base and mouthpiece are injection molded in one cavity, and drilled to accommodate the rivets which attach them to the body of the megaphone. The handle is molded separately in a single-cavity die.

Credits—Material: Lumarith. Molded by Cruver Mfg. Co.



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ALL PHOTOS, COURTESY PLASTOLITH CO.

1—In this transfer printing process using plastic plates, the image first is imprinted upon a rotating rubber blanket, then on the paper sheets. As a final step after being clamped onto the cylindrical press, these plastic plates are here sponged free of gum

Photolithographic printing plates

WHEN, after eleven years of experimentation, William C. Toland and Ellis Bassist took out a patent last March for a plastic photolithographic printing plate, the cycle of photolithographic history was completed. Old advantages were restored which had been temporarily lost when stone was superseded by metal as a printing base, and new, hitherto undreamed-of advantages were added.

Like many other inventions, this revolutionary technique in offset printing came about by accident. "We had no thought," says Mr. Toland, "of making a plastic plate at first. Our idea was to develop a colloid (polyvinyl alcohol) with which to coat metal plates in order to get a better quality print. Then we discovered that the metal had nothing to do with the printing process—that we were printing from the colloid coating, not the metal, and that wood or any other substance might have been used as a support for the colloid."

Actually, paper was selected as the most economical material for this base. But since none of the paper makers approached seemed able to manufacture a paper which would not stretch or shrink when it was wet, the inventors had to develop their own medium. After experimenting with over a hundred plastics, they hit on a chemical means of incorporating a polyvinyl alcohol resin into the paper so that water had practically no washing-out effect on the alcohol.

The next step was to make the plate. Two pieces of ordinary kraft paper were laminated with waterproof urea-formaldehyde plastic resins to form the base of the plate, which was coated on both sides with another layer of the same resin. The upper, or printing, side was then coated successively with three layers of polyvinyl alcohol and clay. The first of these clay layers served to cut down the water receptivity of the alcohol; the second (of calcium carbonate) was the etching base; and the third provided traction. The reverse side of the laminated plate was coated with casein—purely a dressing-up process, since other plastic materials might have been used for the purpose.

Binding the vinyl alcohol to the urea formaldehyde was the most difficult part of the job, since it was necessary to produce such firm and permanent adhesion that the suction pull of the printing press would be overcome. This workable weld was finally achieved, and the result was a resilient, tough, waterproof plastic plate that handles much more easily than a plate of metal.

The method of printing one of these plastic plates is the same as for a metal one. After the plate has been sensitized with a solution of albumen bicromate of ammonia and dried, the subject to be printed is placed upon it and the plate inserted in a vacuum frame. A few seconds of exposure to light from a carbon ray lamp results in the transference of the image to the polyvinyl alcohol resin surface, which is then coated with developing ink, washed under water until the print is clear, and etched with a nitric oxylic and hydrochloric acid solution. The final step is to fasten the plate to the offset press, which transfers the print to a rotating rubber blanket from which the actual copies are run off.

The Toland-Bassist invention, now being produced in quantity, is the only plastic plate in the photolithographic field now suitable for original photo-engravings. The others all require a basic metal plate. Unfortunately for the metal-

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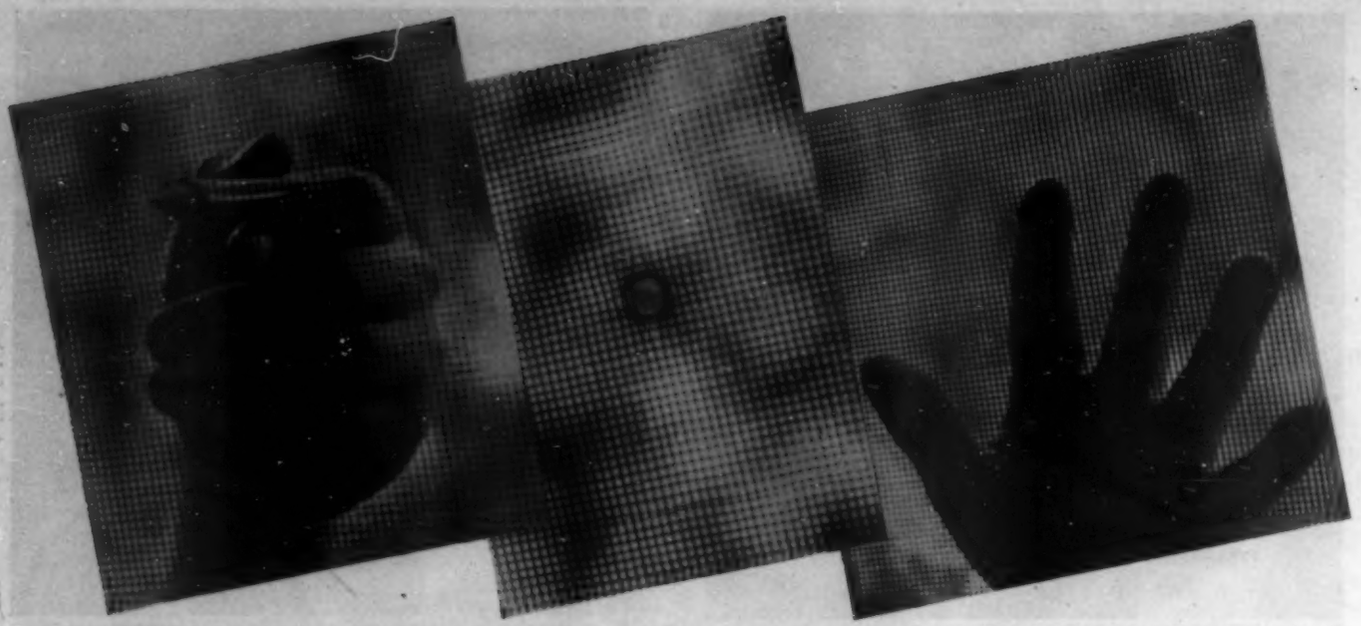
starved commercial lithographer, right now the entire output of these plates is going to Government agencies and to the Army, which uses them for colored maps, for military documents and for the work of its mobile field units.

There are a number of reasons why polyvinyl alcohol resin plates are particularly suited to the needs of the Government agencies and the military. One is their extreme lightness. They average from one-fourth to one-eighth the weight of a copper plate of the same dimensions and cut shipping costs accordingly. They have a hard, flinty surface which is not easily scratched, and if by any chance they are damaged it is not difficult to repair them. Unlike metal plates, they do not need to be insulated from the effects of air or water by a protective coating after they have been used, since they are quite impervious to the action of either element.

This means a saving in both labor and space since, after a plastic plate has performed its required run, it can be washed out with turpentine, put under asphaltum, and then hung up out of the way until it is needed again. Another labor-saver is the fact that instead of using a coating machine to apply the sensitizing solution, as in the case of the metal plate, the plastic plate can be merely rubbed over with a soft cloth dipped into albumen bicromate of ammonia. It is easy to see the great practicability of such a feature to a mobile field unit somewhere in North Africa or—for that matter—to a photo-engraver whose shop is already crowded with cumbersome equipment. Furthermore, by the use of a special ink developed for the purpose, corrections can be made directly on the plate. A plastic plate may also be inserted in a typewriter, typed up, and then put through the lithographing machine to print as many copies as needed.

Here the question naturally arises: What kind of print does one get from a polyvinyl alcohol resin plate? In this connection, an interesting observa- (*Please turn to page 126*)

2—The first step in printing plastic plates is application of a coating of developing ink after exposure under a carbon ray lamp has transferred the desired image to the plate surface. 3—Developing ink clings to the lines of the image; excess ink covering the unmarked surface is washed off. 4—Prior to being put on the press, the plate is carefully checked for accuracy. 5—Here the plastic plate is being clamped on the offset printing press



ALL PHOTOS, COURTESY E. I. DU PONT DE NEMOURS & CO., INC.

1—Damage being done to the screen (left) would spell ruin to ordinary wire netting, but not to screens of extruded nylon. The strength and resiliency of nylon "wire" causes the hole (center) to disappear when a finger is rubbed back and forth across the parted strands (right), returning them to their original positions

Screens without holes

WITH wire screening almost unobtainable, and the most modern of the insect-excluding materials shipped to the war areas, America faces an uncomfortable summer on the home front. Grotesque patches will struggle to cover holes rusted and torn in wire window netting and screen doors. Such fly swatters as lie ready to hand will not be the wire contraptions of the past but rolls of yesterday's newspaper, and even this makeshift defense may become ineffective if newsprint is curtailed to a point where magazines and newspapers are too thin to make substantial cudgels! Adding to the misery will be the knowledge that a screening is now in manufacture which will do away with patches and—obviously—with fly swatters. This nylon window screening is presently being tested for military application, but the civilian will not find it on the market until after the war.

Chemically made, nylon netting has all the advantages of metal screening and some special ones of its own. No painting is necessary since any color can be "ingrained" in the nylon as it is being spun. The material is resistant to rust or corrosion, so there is nothing to peel off and run down the window frame, leaving ugly yellow stains beneath the sills. This corrosion resistance is of particular importance along the seaboard where salt spray boosts the mortality rate of wire netting to astronomical figures.

Tests have proved nylon screen to be both strong and resilient. No permanent bulge is left when something bumps against it. Of even greater interest to families with children is the fact that pencils and other sharp-pointed objects can be shoved through the screen without damage (see Fig. 1). The elasticity of the nylon strands is such that the "wires" can be returned to their former position by the simple process of rubbing a finger back and forth across the hole. It is anticipated that in many homes screens no longer will be taken off as winter approaches; they will be installed so as to roll up and down on tracks, much like window shades.

The idea of using nylon in the manufacture of window screening originated with tests made on nylon toothbrush bristles when the resistance of these bristles to water, many chemicals, and to repeated bendings suggested this new application of spun nylon in requisite lengths. Work on the development was begun back in 1940, and screens installed at various points indicated, when they were taken down and tested, that the material showed promise. (*Please turn to page 128*)

2—In weaving nylon screen, the shuttle is passed back and forth by long, steel arms. Finished screen passes over a breast roll at front of loom which holds it taut, and is wound on another roll at the operator's feet

Liquid phenolic resins for tooling

by K. J. LEEG*

THE increased importance of liquid phenolic casting resins in commercial applications, emphasized in several recent articles in the literature[1, 2, 3, 4, 5, 6] may be attributed largely to the ease with which the liquid resin can be handled and the amount of time and effort saved in making plastic pieces, most of which have been used in tooling applications.

The resin is obtained as a liquid of comparatively low viscosity (about that of syrup or varnish) and is thoroughly mixed with a liquid catalyst before a filler is added. Usually from 10 to 30 percent of the total weight of the mix is filler, the amount used being dependent upon the viscosity desired. When the filler has been thoroughly incorporated into the resin, the mixture is poured into a mold made of plaster of Paris, wood, glass, rubber, metal or other materials, usually coated with lacquer which acts as a separating medium between the mold and the plastic. After it has been baked for 2 to 12 hr. at about 170° F., the plastic is thoroughly hardened and is easily removed from the mold since it shrinks slightly on cooling. The finished plastic piece duplicates the surface of the mold, so little or no finishing work is required.

Liquid phenolic casting resin differs from the cast phenolics in the following respects: its mol ratio of phenol to formaldehyde is different; an external catalyst is added at the time the plastic is to be used; fillers are usually used in the liquid phenolic resin; and substituted phenols may be used in place of phenol.[7]

As has already been implied, the liquid phenolic casting resins are thermosetting phenol-formaldehyde resins that are stable at ordinary temperatures until they are mixed with their catalysts, at which time they are set up rapidly to a hard, infusible, insoluble plastic. The product has a compressive strength of from 6000 to 12,000 p.s.i., depending on the conditions under which it was set, the amount and kind of filler used, and variations in the resin itself. The tensile strength is from 3500 to 7000 p.s.i., and shear strength approximately 3500 to 5000 p.s.i. The impact strength measured with the standard notched Izod specimen is 2 to 3 in.-lb. per in. of notch. The plastic is usually rather light colored and can be made practically white. It is easily colored with organic dyes and pigments, but the colors have a tendency to fade.

It is a good electrical insulating material and has many applications as an insulating and supporting material for electrical work, due partly to its extreme adaptability. A particularly good place for this application is in setting wiring systems in such a way that they cannot be disturbed, the method serving to insulate the systems at the same time. The wiring system is installed and completely finished, and then set into the box in which it is to be used or placed in a temporary box during the casting operation. After the necessary leads are extended through the box, the plastic is mixed and poured into it, filling it and covering all wiring. The whole unit is then baked to set the plastic, and the finished product is tamper-proof.

When liquid phenolic resin was first suggested for use in tooling applications, several difficulties were encountered, the first of which was caused by its shrinkage during setting. This shrinkage, largely due to the material's coefficient of thermal expansion, was in many cases small enough to cause no difficulty, but in others had to be taken care of by the use of a shrinkage rule. The normal shrinkage of the plastic

* Plastics Div., Baker Oil Tools, Inc.

1—For production runs, the use of gang hydropress dies is made possible by reduced costs when liquid phenolic casting resin replaces metal. 2—Plaster of Paris mold being removed from a stretch-press die. The plastic die, which weighs approximately 600 lb., is practically in finished condition when removed from the mold

PHOTOS, COURTESY DOUGLAS AIRCRAFT CO.

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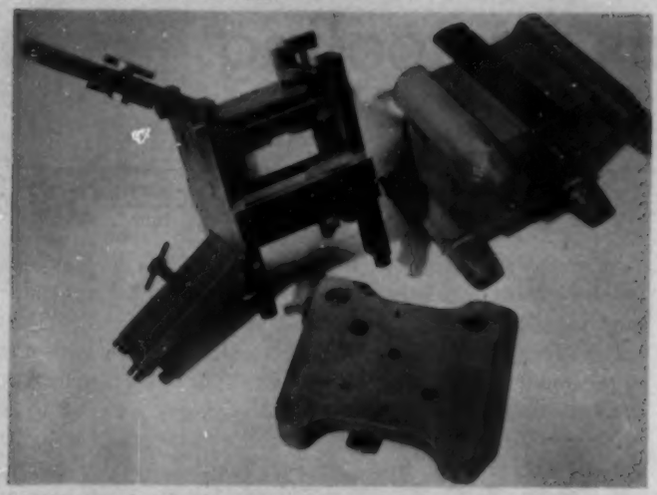
PHOTOS, COURTESY VEGA AIRCRAFT CORP.



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PHOTOS, COURTESY DOUGLAS AIRCRAFT CORP.

3—Plastic box drill jig and (left) steel jig it replaces, open to show construction. 4—Closed view of box drill jigs. 5—Jig with base molded of liquid phenolic resin, hold-down section fabricated of phenolic laminate

when used with organic fillers or no filler at all is about .007 to .008 in. per in. when set at 170° F.

When the plastic is molded in smooth-surfaced glass, copper, bronze, brass or tinned metal, no difficulty is encountered. However, if the mold is of steel, plaster of Paris or wood, the surface must be coated with clear lacquer or nitrate dope to prevent the plastic from sticking to the wood or plaster or failing to set up satisfactorily. If lacquer is used as a parting agent, the film must be heavy enough to be relatively non-porous so the plastic won't stick to the molds. Although this can be accomplished by applying several coats of the lacquer, it would be desirable to seal the mold surface with one coat and thus reduce the time required in preparing the mold. Studies along this line are now being conducted.

Another difficulty encountered is the tendency of the plastic to shrink an additional amount upon aging. This problem has been satisfactorily solved for most applications where the casting is over 1 in. in thickness by using asbestos in place of organic fillers. While this filler gives a product that is somewhat more expensive, the additional cost is justified by the smaller after-shrinkage and the somewhat higher impact strengths obtained. Where very thin sections are used, the aging shrinkage may still be a factor that must be considered.

In general, the material can be used in all tooling applications that do not require an extremely high-impact-resisting material or extreme dimensional stability. Specifically, this plastic has been used in the manufacture of hydropress dies, stretch-press dies, jigs, fixtures and related applications. Figure 1 illustrates a group of plastic hydropress dies which have made several thousand parts without breakdown. The cost of making the plastic dies was so far below that of the metal dies which they replaced that it was possible to use gang dies.

Figure 2 shows a plaster of Paris mold being removed from a medium sized stretch-press die. This die was about 3 by 4 by 2 feet and weighed approximately 600 pounds. As can be seen, the plastic die is practically in finished condition when it is removed from the mold, and ready to be put into production. Many of the stretch-press dies of this general type are cored to lighten them and decrease their cost. The cores are usually made to the general contour of the die and frequently decrease its wall sections to about 4 in. in thickness. Cross ribs are retained for strength.

Figures 3 and 4 show a plastic box drill jig beside the metal drill jig it replaced. The former jig required about 50 hr. of skilled labor to manufacture, while the plastic jig that replaced it was made in four hours.

In all of these applications the liquid phenolic casting resin has usually replaced steel, duralumin and zinc alloys, and has saved a great deal of time in making the tools, in addition to it requiring the use of simpler, less critical equipment. It has also shown itself to be superior to these metals in that it is far lighter in weight, the specific gravity of the plastic being about one-half that of the duralumin and about one-sixth that of the zinc alloys. Since it is usually removed from the mold in a nearly finished form, it requires far less clean-up and hand-finishing than do the materials it has replaced.

The weight advantage, which has been of extreme interest since it came into use, is becoming more important as women are replacing men in industry. The advantage of using a die of one-sixth the weight of a zinc alloy die to do the same job is perfectly obvious, especially if the die must be handled and moved constantly by women (*Please turn to page 134*)

Housewife's helper

WHEN Grandmother washed the windows, she used a cleaning powder, applied with elbow grease in stiff doses. Her grandchild, brought up to scorn such primitive and tiring methods of housekeeping, uses a liquid cleaner to remove dust and juvenile fingerprints from glass surfaces. What's more, she expects to apply this time-saving solution with a spraying device. In the past these applicators were made of metal, but even before the war made material substitution advisable, manufacturers recognized that the sprays lacked eye appeal.

Faced with the problem of finding a material which would meet competitive costs, be attractive and yet withstand reasonably hard usage, the manufacturer selected a vinyl plastic molding compound, because of such outstanding characteristics as stability, non-toxicity, negligible water absorption, and resistance to a wide range of chemicals—all necessary for this application. Principle of the sprays is that a liquid has pressure exerted upon it by a plunger which forces it centrifugally through an orifice. Since very close tolerances are required for this operation, considerable skill and ingenuity were required in the design and the preparation of the molds.

The applicator consists of a nozzle and spinner which provide the actual spray; the head or finger rest; a piston with a secondary valve at the top; a cylinder with an integral cap; a collar which holds the piston in place; a spring to actuate the piston; a primary valve located at the bottom end of the cylinder, and a stem of variable length to fit different sized bottles. A complete unit is shown above.

An insert system of mold construction was employed. Since running water was used to eliminate accumulative heat, small cavities were located away from the water course to avoid difficulties in filling them.

The first mold (Fig. 1), upon which all experimental work was carried out, had enough inserts to produce only one complete sprayer. In this mold an air cylinder was mounted to operate a gear rack which in turn rotated the threaded cores out of the molded cap. As a result of experience with this mold it was learned that a modification was necessary to eliminate sharp edges at the parting line of the cap skirt which might cut the fingers when pressure was exerted.

Sixty days after start of production, work was begun on a second mold (Fig. 2), capable of producing parts for two complete sprayers with 28-mm. threaded caps. A geared mechanism to rotate the cores from the threaded cap, housed within the mounting and operated by the ejector plate, was substituted for the relatively slow-operating air cylinder. To overcome the sharp corner at the bottom of the skirt, the parting line on the cap was raised $^1/_8$ in. on the perpendicular side. The piston and cylinder fit was cast to finished size with a .001-in. relative clearance. Over a million units had been produced from the second die by the time that metal sprayers went off the market for the duration, and the manufacturer decided to enter the field in a large way with a more economical plastic sprayer.

Faced by mass production problems such as increase in the machine operating cycle, cut in the amount of material per unit and greater cap and stem range, a new mold was designed (Fig. 3) capable of producing 4 complete sprayers with 2 extra of the 3 smaller pieces to keep parts in balance. Uniform and minimum wall sections of all parts permitted an increased operating cycle, while the yield in completed sprayers per lb. of material used rose from 22 to 50. The cap range was increased to 22, 24, 28 and 50-mm. sizes by the use of stock metal or molded caps; while extruded tubing cut to lengths required to reach to the bottoms of the various sized containers was substituted for short molded pieces, welded together.

A change in the design of head and nozzle did away with the spinner and, by accommodating the solid height of the spring inside the piston, per- (*Please turn to page 132*)

1—This original mold produced one sprayer. Changed cavities for the outside, threaded cores for the inside and altered gear mechanism permitted its use on bottles with 24, 28 and 30 mm. caps. 2—While the second die produced 2 sprayers, only one cap size was molded. 3—Die now in use molds 4 sprayers except for stems and caps. The collar is designed to accommodate molded stock caps with domes of varying thickness

1 ALL PHOTOS, COURTESY WILCO CO. 2 3

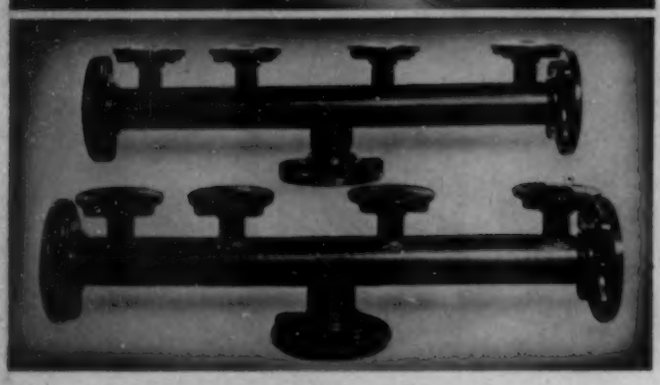
PLASTICS IN REVIEW

1

1 From now on, if your voice cracks during a recording you alone will get the blame. Danger of breakage and needle scratch has been reduced to a minimum in these recording disks with bases of thick glass. Heavily coated with nonflammable transparent cellulose acetate by the dipping process, the disks are safe for home use. H. & A. Selmer, Inc., are the distributors

2

2 In step with recent improvements in the coloring of margarine, the Margi-Mold Co. has adopted a plastic mold which brings its product still closer in appearance to butter. Molded by Allied Plastics Co., the margarine mold is composed of a material consisting of four parts of Lumarith reground with one of soft-flow cellulose acetate. Odorless and tasteless, the plastic will have no effect on the margarine



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3 Designed for industrial and chemical use, these Saran pipe assemblies were fusion welded by Technical Plastics Co. for Williams and Co., Inc., to replace hard rubber piping for corrosive acid solutions. The 4 outlets on each assembly are fusion welded to the main body while all flanges are standard molded. Tough, abrasion resistant, long-wearing, these injection molded pipes, ranging from ½ in. to 2 in. in diameter, also can be used in place of metal for the handling of acid, gasoline and oil

4 Lunch holds no secrets with this all-plastic lunch kit fabricated by Great American Plastics Co. from cellulose acetate for Irwin Corp. Handle and holders for the thermos bottle are of extruded plastic as are the base and ends, so drawn as to include place for a nameplate. The corrugated clip to lock the cover is formed of extruded strip. Screwposts for fastening the handle are attached to the thermos suspension, so balanced as to create no strain. The kit can be fabricated in various opaque colors

5 Crayon pencils are essential equipment for most manufacturers, wholesalers and retailers, permitting easy marking on metal and glass. In this mechanical pencil everything is molded of Tenite with the exception of the lead and a sleeve used to hold the crayon in the tip, which is formed from a drinking straw slotted and dipped in an acetate-acetone solution to form a bead around the lower rim. The plastic pencils are in great demand by aircraft manufacturers, who find them useful for layout work. Molded for Listo Pencil Co. by American Molding Co.

6 When electric outlets are to be tested and fuses pulled, these Star Fuse Co. pocket pliers molded of Lumarith come into service. Plugged into a light socket they will detect blown fuses and determine voltage. For this work the flexibility of Lumarith allows an adjustment to the load, thereby minimizing breakage; its transparency enables the worker to see the point of work. The pliers are injected molded by Kuhn & Jacob Molding & Tool Co. in a 4-cavity mold under 20,000 lb. pressure

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7 Workers will have no cause for complaining of unwieldy tools with this Eclipse Air Brush Co., Inc., spray gun molded of high-impact black Bakelite at about 25,000 lb. p.s.i. by Mack Molding Co. The finished gun weighs less than it did when made of aluminum, thus lessening the strain on the user's arm and cutting down fatigue. The plastic is resistant to chemicals, shockproof, and withstands lots of hard wear

8 Complete insulation from metal or "body capacity" together with resistance to abuse are requisites for wrenches used to adjust condensers in high-frequency radio equipment. These socket wrenches, fabricated from ½-in. Plexiglas rod stock to fit hexagonal nuts, are produced by Klise Mfg. Co. for Wells-Gardner & Co. to replace a fibre tool. Life of the wrench is extended by broaching the working end to a depth of 1 in. to permit cut-offs when wear occurs

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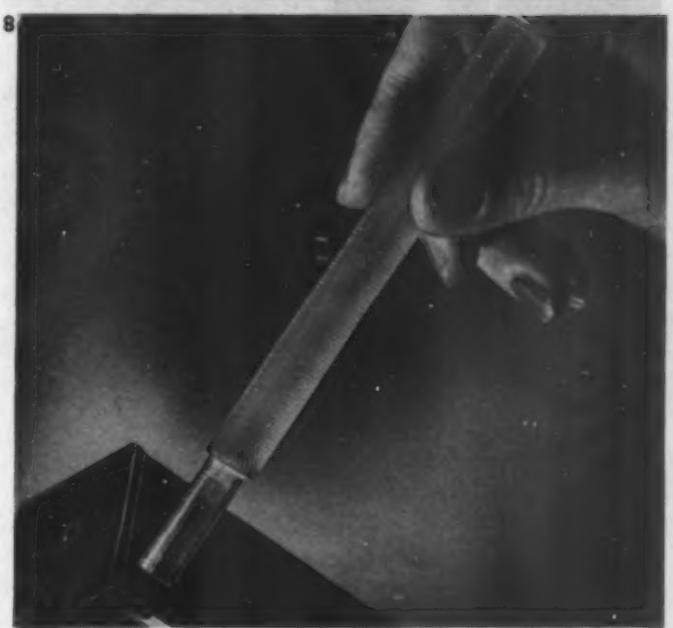

9 Wearers of glasses no longer need suffer the discomfort of cumbersome safety goggles. Safety masks of Lumarith and Fibestos, fabricated by DuBois Plastics Co. and distributed by American Allsafe Co., have overcome this difficulty. In addition to being light in weight and affording complete visibility from all angles with maximum protection, the goggles are fitted with eyepieces which easily can be replaced when scratched or damaged, simply snapping into place

9

10 With every forced shutdown of a loom, another dress disappears from the American woman's wardrobe. In one New England textile mill these interruptions have been reduced by the adoption of thread accumulators fabricated of tough Lucite sheet. Impervious to breakage, these transparent cylinders permit an operator to watch the process whereby the filling end from a new bobbin at transfer and the cut ends from the ejected bobbin are sucked into this central container, and to determine when they need to be cleaned. The cylinders are supplied in standard 52½-in. lengths, yielding 8 accumulators

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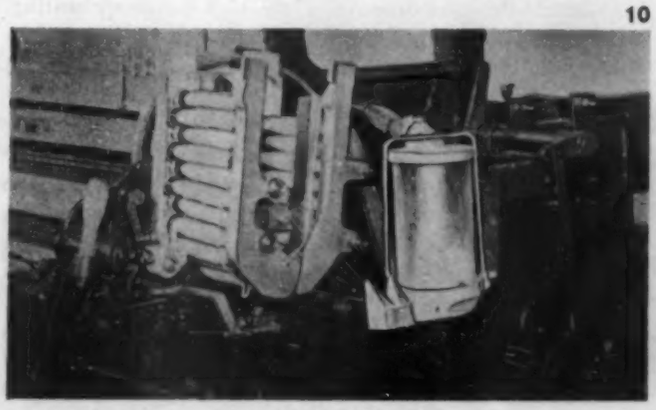

The function of postwar research

by ARTHUR J. NORTON

ARTHUR J. NORTON

ARTHUR J. Norton, technical consultant, has moved his industrial research laboratories from Portland, Maine, to Seattle, Washington. Since 1938, when he opened his Maine laboratory, Mr. Norton has been engaged in research and advisory work for the plastics and chemical fields. Before embarking on this research work, he was connected with Durez Plastics and Chemicals, Inc., in the capacity of chemical director. From 1935 to 1938, he was operating head of the plastics division of Detroit Paper Products Company.

Among the factors motivating Mr. Norton in his move from the East to the West Coast were 1) the increasing use of resins in plywood manufacture and in aircraft construction, two important West Coast industries, 2) the forests of the Northwest which are among the greatest sources of cellulose and lignin, themselves sources of important plastic materials, 3) the cheap power and abundant natural resources of the West, which serve as a basis for the production of chemicals for plastics and 4) postwar booming of air trade with the Far East that will make the Northwest an important plastics center, at least for raw material supplies.

Before leaving for the West Coast, Mr. Norton offered the following statement on the future of the plastics industry:

The future of the plastics industry will depend to a great extent on the type of research work done. Research must be guided into channels that will expand present markets, allow the opening of newer and bigger fields. To meet the present emergency, we really have been drawing on the reservoir and backlog of accumulated "pure" research. If the war is long and pure research is neglected, the plastics industry after the war might well drop into its old niche and remain static for several years. I personally do not believe this is happening or will happen. I feel, to quote Mr. Churchill's recent reference to the war, that "We have just reached the end of the beginning," that the growing pains of the industry have been overcome and the real fundamental growth just started. The rapidity of growth, the directions and extent of expansion all depend on farsighted research, not only scientific, but in marketing and in production as well.

One of the first advances for which I feel we now are ready is mass production in the true sense. But the greatest needs for expansion into new markets not available today—needs which can be satisfied by research alone—are: greater strength in plastic materials and lower cost molding and fabricating methods.

Greater strength can be approached from several angles. The increased strength of the resins or plastics themselves, without the use of fillers, is a bona fide pure research problem. "Pure," because without question the production of a thermosetting resin comparable in fabrication methods and final properties to the standard phenolic but with 25 percent greater over-all strength would quadruple the possible usage. This estimate is based only on markets available at the present time. It would not displace the present material but open markets for which the present strength is not enough. Such a problem is a long-range, difficult one, for there is little background yet accumulated to guide the start of the work. It is not an impossibility, however, for present resin strengths are but a tiny fraction of the theoretically possible strength to be achieved from the carbon-carbon bond which is the base of most plastics.

The use of fibrous fillers for increasing the strength of molding compounds is old in the thermosetting field. The handicaps of handling due to bulk gradually are being overcome through mechanical processing methods, and no doubt many more advances are possible. Difficulties due to lack of flow are being minimized with electronic preheating. It seems safe to predict that the increased use of this type of "extra strength" material stimulated by the war demands for stronger pieces will not slip back if improvements in mechanical handling continue at last year's rate.

The possible markets for very large moldings are here and increasing. Table tops with the edges all formed, door panels for automobiles, bathtubs, etc., all appear practical if the right materials and processes can be developed.

One such process now is well on its way and bids fair to be one of the biggest developments plastics have known for some time. It is the application of pulp molding technique to fiber-resin preforming (see page 76). By this technique, from a thin slurry in water, fibers and resin may be preformed into curved sections approximating the finished article. All the fibers are laid up uniformly and interlocked. The final "molding" is really just a compression and gluing operation. Many basic studies on methods of resin dispersion or impregnation in the fiber mats, many on drying and forming technique, on fiber types, methods of putting high resin surfaces on low resin cores and a thousand other details must be made before the process becomes a highly important factor. However, enough already has been accomplished to convince me that this general process offers the most immediate answer to the molding of large semi-structural units.

Of course the other improvements—high frequency heating, fluid pressure molding and resin strength—can be applied to this process. Here, too, thermoplastic colored surfaces could be applied on thermoset cores to give dimensional stability with decorative effects.

Laminating impregnated paper, cloth and fibers is another way of getting strength from fibers. Improvements in the papers and in the knowledge of the use of mixed laminates, together with lower pressure molding techniques, make it possible that a large percentage of the gains in this branch of the industry brought about by war demands may be held. However, only simple curvatures are possible here. It is likely that the more intricate designs will take over most of the important curved section work. (*Please turn to page 130*)

A game that founded an industry

by HAROLD J. LUTH*

NO article appears to stimulate so much interest or so many misconceptions by technical men and laymen alike as the billiard ball or—as it is more usually thought of—the "pool ball." It is an enticing thing; the brilliant colors and attractive design interest the layman, and the possible construction arouses the curiosity of the technical observer.

The company with which the writer is associated has been engaged in the manufacture of billiard equipment since 1845 and has been intimately linked with the molding art since the days when plastics were in their infancy. The writer himself became involved in the making of billiard balls shortly after leaving engineering school 18 years ago. Because the molding of billiard balls was one of the forerunners of the molding industry of today, some of its history should be given before we talk about the present-day article and how it is made.

It is an intriguing idea that the plastics industry owes its beginning to a game, and there is much evidence to substantiate just that possibility. The origin of the game of billiards is obscure. It is thought by some that the game was brought from the East by the Crusaders, but there is some evidence that a French artist, Henrique Devigne, designed tables and drew up a set of rules for the court of Charles IX. Billiards started as an outdoor game, using two stones for balls. In the 18th Century a third or carom ball was introduced. After 1823 billiards became increasingly popular in the United States, often played on tables built with marble or slate tops. In 1854 Michael Phelan invented the rubber rail cushion, and the game became one of "scientific precision," with ivory the preferred material for the three balls. Just when pocket billiards or pool came into favor is vague but probably about 1860, and the numbered balls were made by surface-coloring the ivory and engraving the numbers.

The game's big contribution to the plastics industry came when a $10,000 prize was offered by the firm of Phelan and Collender (now Brunswick-Balke-Collender Co.) to the person who could produce a satisfactory substitute for billiard-ball ivory. As a consequence, the first American plastic, celluloid, was made by John Wesley Hyatt in 1868.

Braconnot had nitrated carbohydrates in 1832, and in 1847 Maynard put nitrocellulose into solution with wood alcohol to make collodion. Parkes and Spill in England made solid compositions from collodion with oils for plasticizers, and Parkes in 1868 (English Patent No. 1614) used starch wheat flour or cotton fiber with pyroxylin to make a billiard ball composition. However, it is acknowledged that Hyatt's work was done independently and with no knowledge of the work of Parkes and Spill.

Hyatt's first patent in 1869 (U. S. Patent No. 88,633) describes a molding composition which imitates ivory composed of fibrous materials and gum shellac or other solid fusible adhesive gum. His next (U. S. Patent No. 88,634, April 6, 1869) improved on billiard balls by providing for dipping them in a solution of colored collodion; and another (U. S. Patent

* Director of Research and Engineering, Brunswick-Balke-Collender Co.

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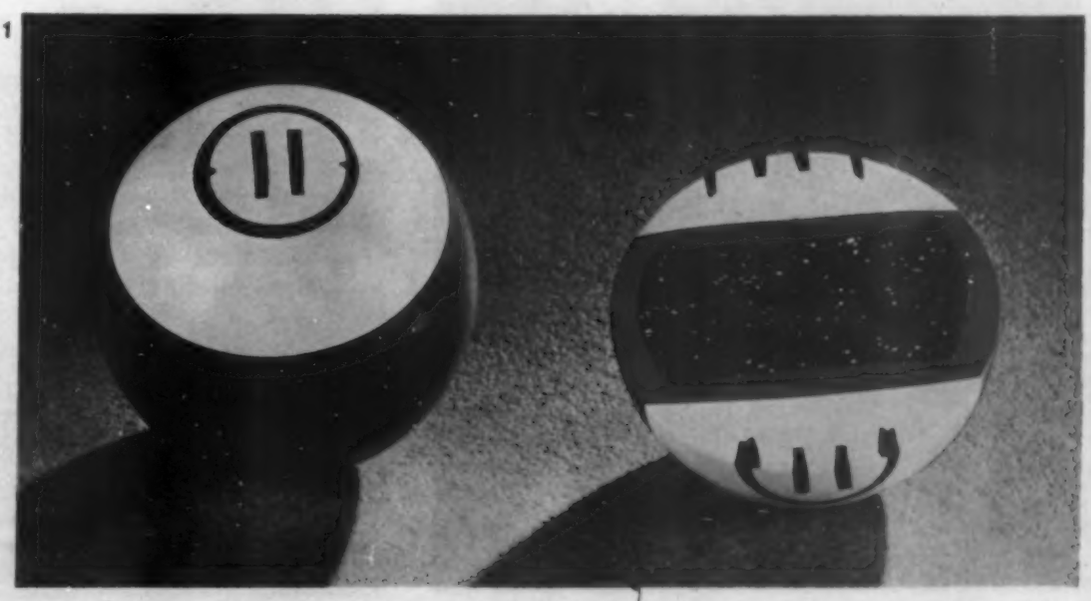
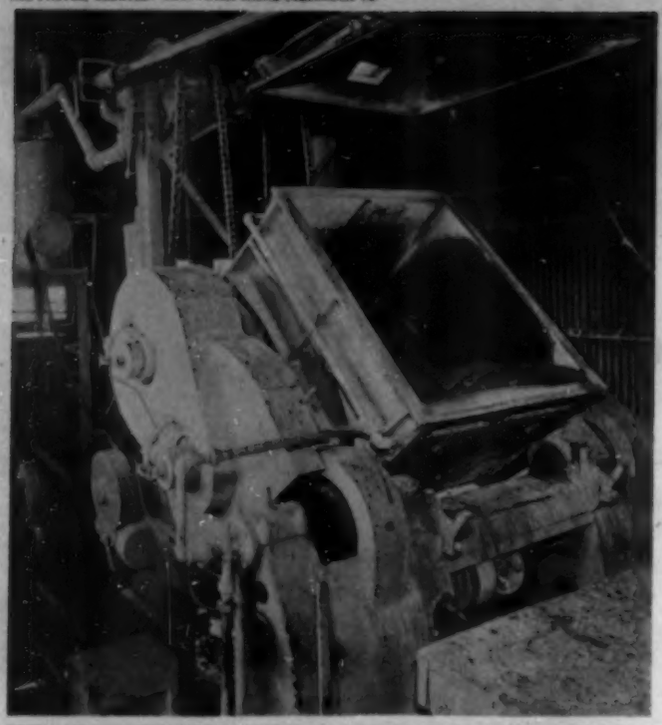


1—A numbered billiard ball sliced in half looks like this. Compression molded in progressive stages of a cellulose nitrate composition, its core, colored band, and black figures in their white field are securely bonded together in a finalautoclave operation

ALL PHOTOS, COURTESY BRUNSWICK-BALKE-COLLENDER CO.



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No. 89,582, May 4, 1869) was granted for a composition consisting of ivory dust or a similar substance mixed with collodion and subjected to pressure during evaporation of the solvent. U. S. Patent No. 91,341, granted June 15, 1869, to Hyatt and his brother related to the manufacture of "plastic" collodion using very little solvent, the product to be submitted to heavy pressure in the molding.

U. S. Patent No. 105,338, July 12, 1870, describes the invention of celluloid. The story goes that Hyatt's father, a blacksmith, had a set of steel rolls for rolling iron wagon wheel rims, and that on these rolls Hyatt mixed his cellulose nitrate and camphor, subjecting the mixture to heat and pressure to mold it. This patent the brothers titled "Improvement in Treating and Molding Pyroxylin," and they claimed a method of manufacturing a solid product from nitrocellulose and camphor, their three claims being:

1. Grinding pyroxylin into a pulp as used for the purpose described.
2. The use of finely comminuted camphor gum mixed with pyroxylin pulp and rendered a solvent thereof by the application of heat substantially as described.
3. In conjunction with the use of camphor gum the employment of pressure and continuing the same until the mold and contents are cooled substantially as described.

And so perhaps it is not an overstatement to say that a game started an industry.

The manufacture of billiard balls today has, of course, come a long way from processes of the Hyatts. Present-day knowledge and techniques are used to their fullest extent, which means that the product itself is greatly changed. Although the numbered balls are a cellulose nitrate molding composition, the cue and carom balls utilize phenol-formaldehyde compositions, cast phenolic resins and urea-formaldehyde compositions. Contrary to many speculations one hears on the subject, billiard balls are *not* made of milk, nor are they made of clay.

Because of the particular requirements of the end product, the billiard ball manufacturer must make his own powders, and they are quite different from the conventional molding powders. In play the balls are subjected to abrasion and impact, and where a great deal of "English" is used the balls spin and slide on the cloth in a fashion that would cause the usual materials to burn and abrade from the heat generated at the point of contact. It also is necessary that the balls have the right "click," and they must have resiliency to give life to the play. All these requirements must be met in the formulating and processing of the stock.

Compounds going into the balls consist of the binder—a high viscosity nitrocellulose and camphor; the filler—a hard, high density material; the pigment or dye; and a plasticizer having a critical softening point at a temperature of about 300° F.

To obtain the hardness, resiliency and "click," a high percentage (from 60 to 70 percent) of hard filler is used, pebble milled to a very closely controlled fineness. If we think of the binder as coating the surfaces of the individual particles and

2—Molding compound is mixed in a closed jacketed mixer with a flood pipe connection for dousing contents if fire should break out. 3—High temperatures and short cycles characterize the curing operation in hydraulic presses, here shown with auxiliary cold forming equipment. 4—The experienced operator can tell by the feel of his hand on the cross-feed when the blocks have been machined to exact size and shape on the turret lathe

acting as a cement to weld them together, we can appreciate the importance of controlling the area of the filler surfaces to provide a sufficient and uniform coating of the binder. To demonstrate this idea, let's take a hypothetical example.

Assume a formula of 50 percent binder and 50 percent filler by weight and further assume 1 particle of filler is a cube 1 centimeter square weighing 1 gram. We also will have 1 gram of binder. Now we will start thinking in terms of area: our 1-centimeter cube has 6 square centimeters of surface. Therefore, our proportion is 1 gram of binder per 6 square centimeters of surface. Now, without changing our weight ratio, we will grind our filler so that each particle is split down the middle, and now we have 8 square centimeters of surface. Do it again and we have 12 square centimeters of surface; and from a standpoint of surface binding, instead of 50 percent binder we have only $33^1/_3$ percent binder on a unit surface weight basis.

Study of particle sizes in grinding operations is done in the plant laboratory with that piece of apparatus that many newcomers in the laboratories are sent after as a practical joke, the "Elutriometer." Yes, there is such a thing. You'll find that soil chemists use them. The apparatus consists of a series of funnel-shaped glass vessels varying in size from small to large, one overflowing into the next, with a constant flow of water through the series. A variable velocity of flow results, and the effect is to build up a delta like that formed by the Mississippi flowing into the Gulf of Mexico. The large particles deposit in the small, higher velocity vessels, the very fine wash down to the end of the line, and a fractionating of the particles results. In the plant, once conditions are set, the fineness of particles is controlled by air-floating the ground material from the mill, and collecting it in a dust arrester.

In the earlier days the stock was mixed on rolls essentially the same as those used by Hyatt in his father's blacksmith shop, but for the last 18 years the mixing has been done in a Werner and Pfleiderer mixer. The cellulose nitrate is swelled with alcohols and acetates to a viscous dough, the fillers, coloring materials and plasticizer kneaded in, and the solvents then removed by vacuum distillation.

Fires were a common occurrence when the mixing was done on open rolls and the solvent removed by hanging sheets in a steam-heated drier. The use of a closed jacketed mixer makes fires infrequent and readily controllable, but we still consider it advisable to perform the mixing operation in a separate building which has double-hinged, swinging doors and a roof fastened on by light metal straps. If a vapor flash occurs, the doors swing open and the roof rises to relieve the pressure. Figure 2 shows the mixer, pumps, condensers and collectors. Through the top of the mixer a connection is made for a flood pipe to drown the contents if a fire starts during the mixing operations.

About 90 percent of the solvents are removed by vacuum distillation and the stock disintegrates in the mixer and is discharged in sizes from $^1/_4$ to $1^1/_4$ inch. The coarse aggregate from the mixer is further dried in an atmospheric drier, then passed through a hammer mill, and finally milled in a pebble mill to a particle size of 60 mesh, when it passes over a vibrating screen to remove tramp material or coarse aggregate.

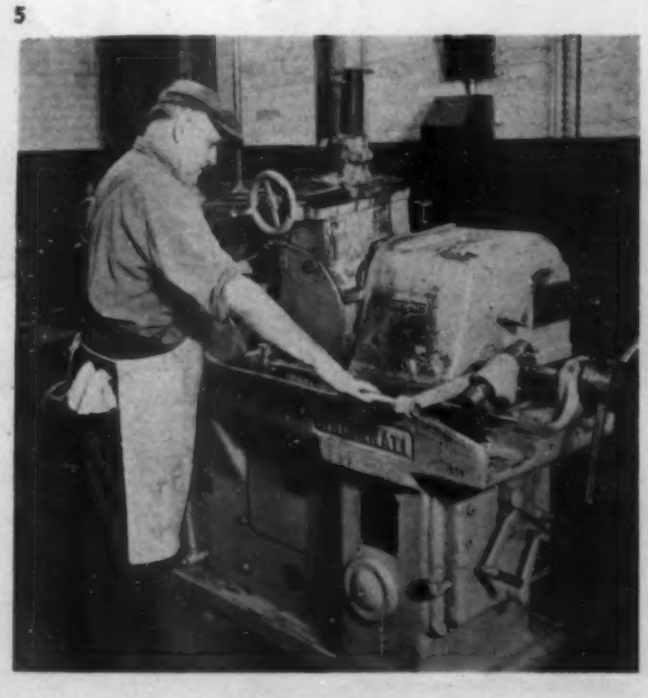
The powders are molded in positive molds using a force and chase and a molding pressure of 5000 to 6000 p.s.i. Because of the fact that the mass of a ball is large and the cellulose nitrate decomposes readily, it is not advisable to mold the entire mass in one piece. Therefore the first step in the operation of molding the ball is to mold a core or center part. This uses exactly the same type of composition as is used for the balance of the ball.

The second step is to mold the colored portion of the ball around the core. It is very important that each section of the ball weld itself onto the next one, and therefore all mold scale is removed after each molding operation on any surfaces where additional material is to be joined. In the third step a cold forming operation is interposed which provides a cavity for the numerals which have been molded previously.

The numeral is molded in two pieces. In the first molding operation, which is also a positive (*Please turn to page 126*)

***5**—Center grinders give the turned balls the desired degree of size and roundness, keeping very close tolerances. **6**—Defective molding is costly. Therefore samples molded from each batch of powder are sent to the laboratory for such tests as abrasion value, Rockwell hardness, shear and compression strength, flow*

5



6

White Spools of Plaskon

...for Wartime Photographic Service

Another use of Plaskon in wartime service . . . sturdy, light weight spools, to carry film for specialized photographic purposes!

Because of censorship restrictions, we cannot reveal the service requirements that will be filled by Plaskon in this new application. But the *features* that made Plaskon essential for this duty are adaptable to your needs also—both for priority war production and peacetime planning.

Molded Plaskon offers a unique resistance to common organic solvents, such as alcohol and acetone, in which it may be immersed for indefinite periods of time without harmful effect, or bleeding of color.

Because of its hard surface and solvent resistance, Plaskon is impervious to all oils and greases. Moldings are completely resistant to chipping, rusting, and corrosion. The color is an integral part of the material, and is not impaired by scratching or abrasion of the surface.

Plaskon is available in a wide range of colors—highly translucent or opaque. It is extremely light, with exceptional flexural, impact and tensile strength.

Delivery of Plaskon is subject to WPB Allocation Order M-331. Our experienced technical men will gladly work with you in adapting Plaskon to your future needs. Plaskon Division, Libbey-Owens-Ford Glass Company, 2121 Sylvan Ave., Toledo, Ohio. Canadian Agent: Canadian Industries, Limited, Montreal, P. Q.

PLASKON

MOLDED COLOR

Phenolic resin-pulp preforms

by R. U. HASLANGER and R. H. MOSHER*

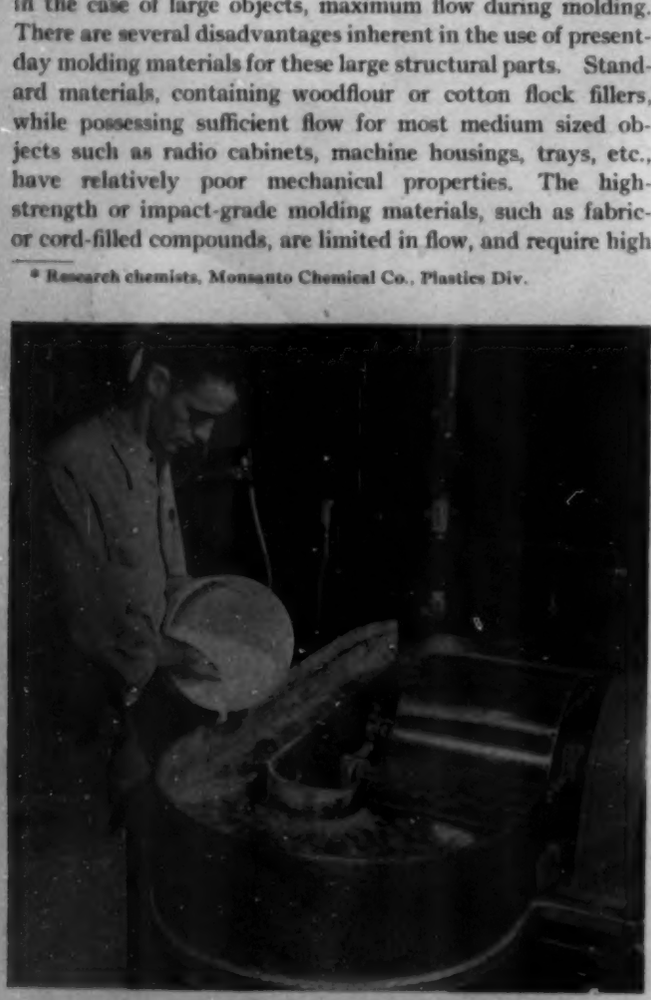
WITH the present-day growth in the plastics industry, phenolic molding materials are finding increased applications in the production of structural parts. These applications require the optimum in physical properties and, in the case of large objects, maximum flow during molding. There are several disadvantages inherent in the use of present-day molding materials for these large structural parts. Standard materials, containing woodflour or cotton flock fillers, while possessing sufficient flow for most medium sized objects such as radio cabinets, machine housings, trays, etc., have relatively poor mechanical properties. The high-strength or impact-grade molding materials, such as fabric- or cord-filled compounds, are limited in flow, and require high molding pressures and consequently heavy presses and expensive molds if large structural objects are to be produced.

* Research chemists, Monsanto Chemical Co., Plastics Div.

During the past several years, a number of materials and methods have been developed to overcome these disadvantages. Both fabric- and paper-base laminates of high strength are being used to produce relatively simple contours having a shallow draw. The laminating material is cut and pre-shaped and then drawn and molded under heat and pressure. Low pressure and bag molding techniques have been employed to facilitate molding this type of product. However, this development has to date of necessity been limited to relatively flat pieces or simple contours.

Perhaps the outstanding new development in this field has been the application of pulp molding techniques to the preforming and molding of fiber-resin combinations. While the art of pulp molding is old and there are a number of well-known concerns in the field, its application to the production of molded plastic structural parts has only recently been investigated commercially.

In the preparation of pulp-resin preforms, a fibrous material or pulp is suspended in a beater of the type used in the paper industry. A finely divided phenolic resin is then dispersed in the pulp slurry in the beater (Fig. 1). The resulting suspension of pulp and resin is accurately vacuum felted to the shape of the finished article (Fig. 2). The water is removed and the pulp preform dried by any one of the various methods employed in the pulp molding trade. It is sometimes desirable to prepare the preform without initially incorporating the resin. In this instance, the pulp preform is impregnated with a resin in solution and the solvent subsequently removed. In either event, the resin-bearing fiber product is compression molded under heat and pressure.



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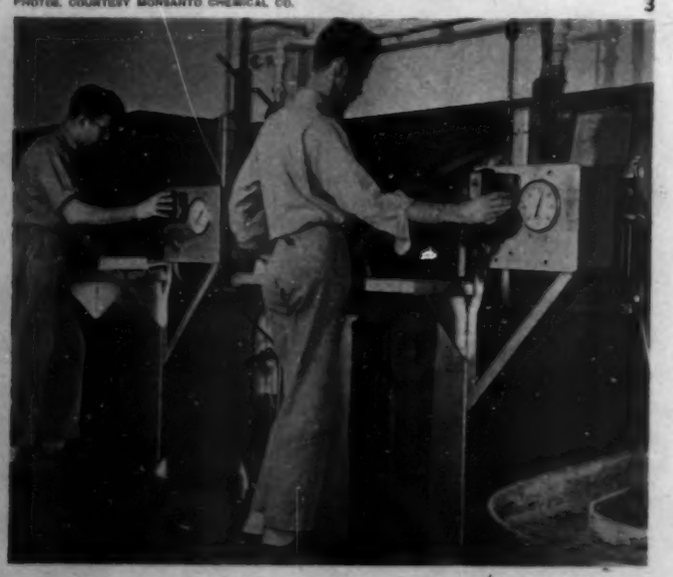
PHOTOS, COURTESY MONSANTO CHEMICAL CO.



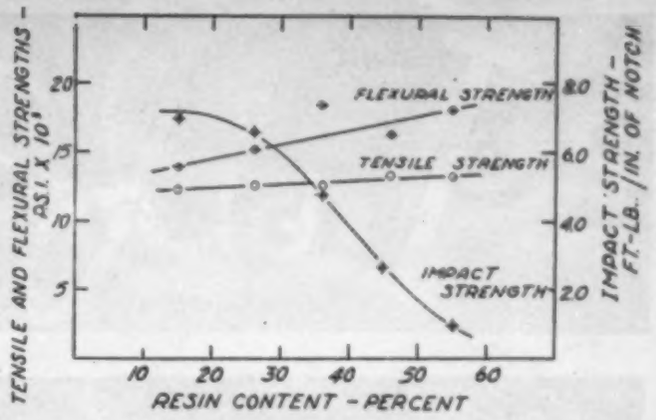
3

1—Finely divided phenolic resin is added to pulp slurry in the beater. 2—Pulp-resin preform is vacuum felted to contour of finished article. 3—Pilot plant set-up for study and application of resins for pulp-resin preforms

The type of fibrous pulp used influences the characteristics of the pulp-resin preform as well as the physical and mechanical properties of the molded article. The formation of the felted fibers throughout the formed piece and particularly at the corners also contributes to the strength of the finished article. Likewise, the resin content may be varied over a wide range, depending on the properties desired in the finished product (Table I, Fig. 4). Since the preform is accurately formed to the shape of the finished object, and contains an intimate blend of resin and pulp, it is possible to mold the preform under a minimum of pressure. Only sufficient pressure is needed to fuse the resin and densify the combination without causing dislocation or flow of the material. This fact makes practical the use of lower pressure molding methods and equipment, and makes it practical to use as low as 30 to 35 percent resin for satisfactory moldings.

The fundamentals of the process are relatively simple. However, its successful application to the molding of large structural parts requires a thorough understanding of the art of pulp molding combined with the cooperation of the plastics manufacturer. In the latter connection, the Plastics Division of the Monsanto Chemical Co. has set up a pilot plant to study resins and their application to pulp-resin molding (Fig. 3). Studies both of beater dispersion of finely divided resins and of the impregnation of pulp preforms have been undertaken in order to select the best resins for these applications. The pulp molding development program undertaken by Monsanto has been worked out in cooperation with the Hawley Products Co. of St. Charles, Ill., who have pioneered in the development of resin fiber pulp moldings for large structural parts. This concern has already licensed several manufacturers and is cooperating with them in setting up pulp-resin operations on structural products.

Experimental work has been carried out on the piece shown in Fig. 2. A complete set of tools for felting, drying by the various methods employed in the pulp molding industry and molding by high and low pressure techniques has been installed. The piece has been so designed that tensile, flexural and impact specimens may be cut from the molded object for evaluating mechanical strengths. Specimens may be cut both from the top and from the side walls to check uniformity of resin distribution. Equipment has also been installed for the preparation of 5 in. × 7 in. slabs of various thicknesses. Standard high impact materials can be molded in the same dies for comparative purposes.



4—Results of tests on kraft pulp-phenolic resin preforms containing varying ratios of pulp and resin

Table I and Fig. 4 give the results of tensile,[1] flexural,[2] and impact[3] tests run on kraft pulp-phenolic resin preforms containing varying ratios of pulp and resin. As may be seen from these data, the tensile and flexural strengths show a slight increase with increasing resin content. The impact strength decreases quite rapidly with increased resin content. However, at 35 percent resin content the notched Izod impact strength is still 4.8 ft.-lb./in. (*Please turn to page 130*)

[1] 1942 Book of A.S.T.M. Standards, Part III. D 638-42T, p. 241.
[2] Ibid., D 650-42T, p. 1068.
[3] 1941 Supplement to Book of A.S.T.M. Standards, Part III. D 256-41T, p. 339.

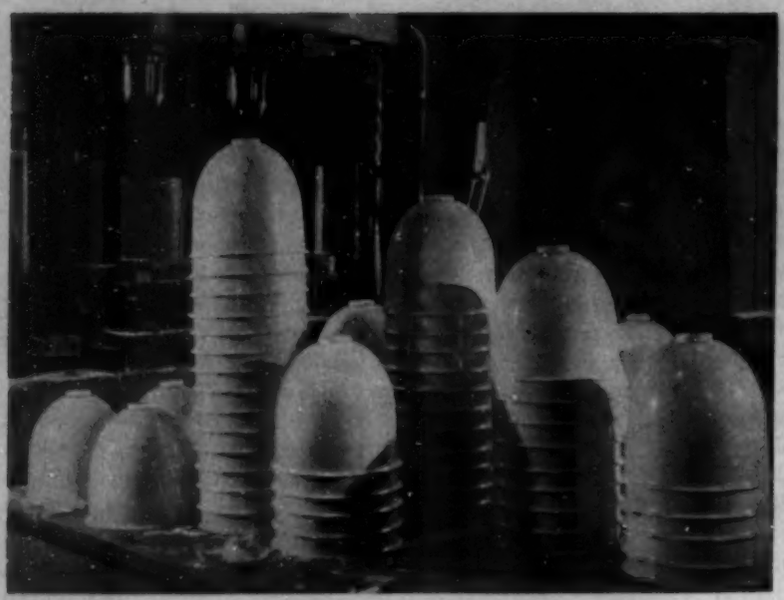
TABLE I.—THE INFLUENCE OF RESIN CONTENT ON THE PHYSICAL PROPERTIES OF KRAFT PULP-PHENOLIC RESIN PREFORMS MOLDED AT 800 P.S.I. AND 320° F.

Resin content	*Tensile strength*	*Flexural strength*	*Impact strength notched Izod*	*Water absorption 24 hr.*
%	*p.s.i.*	*p.s.i.*	*ft.-lb./in. of notch*	%
55	13,400 ± 1130	18,200 ± 1050	1.09 ± 0.18	0.42
45	13,500 ± 1170	16,400 ± 710	2.72 ± 0.16	0.64
35	12,600 ± 1140	18,600 ± 1365	4.80 ± 0.57	0.82
25	12,600 ± 330	15,200 ± 575	6.64 ± 0.78	24.3
15	12,200 ± 1030	14,000 ± 740	6.96 ± 0.64	70.6

TABLE II.—COMPARISON OF THE PHYSICAL PROPERTIES OF PULP-RESIN PREFORMS MOLDED AT 880 P.S.I. AND STANDARD HIGH IMPACT MOLDING COMPOUNDS MOLDED AT 3000 P.S.I.

Material	*Resin content*	*Tensile strength*	*Flexural strength*	*Impact strength notched Izod*	*Water absorption 24 hr*
	%	*p.s.i.*	*p.s.i.*	*ft.-lb./in. of notch*	%
Kraft pulp-resin preform	55	13,400 ± 1130	18,200 ± 1050	1.09 ± 0.00	0.42
60% pulp, 40% macerated fabric-resin preform	55	13,500 ± 689	16,100 ± 1300	2.34 ± 0.03	0.60
Macerated fabric-resin preform	55	9500 ± 705	16,200 ± 490	3.00 ± 0.08	0.31
Macerated fabric filled molding compound	50	5500 ± 855	10,200 ± 550	3.50 ± 0.13	1.67
Cotton cord filled molding compound	50	4800 ± 625	12,400 ± 1050	8.00 ± 0.18	1.91

Life On The



(Above) **NEW STANDARDS OF LIGHTING EFFICIENCY** have been made practical with the design of light-weight, shatter-resistant BEETLE* Safety Reflectors. In translucent form, BEETLE offers high light diffusion and excellent light transmission that suggest many interesting possibilities for postwar design. Shown here are reflectors for use on the famous IES type lamps as they come from the molding press.

(Above) **MADE-TO-ORDER WINTER** is used to study engine performance under sub-zero conditions. Resistance to extreme temperatures plus high dielectric strength (430 Volts/mil.) and high arc resistance (130 sec. average, A.S.T.M.) are reasons why MELMAC 592 is used for many aircraft applications.

(Below) **TIME FOR LUNCH,** suggests this young Miss as she demonstrates a compartment tray molded of chopped-cotton-fabric-filled MELMAC*. High in flexural strength, this new MELMAC is strong, resists impact and is also unusually resistant to hot or cold water, stains and abrasion. Its hard, moisture-resistant surface promotes sanitation.

(Below) **FROM UNDERWEAR TO OVERCOATS,** buttons molded of MELMAC and BEETLE are serving the armed forces. Uniformity, smart appearance and resistance to repeated launderings make these two Cyanamid plastics ideal button materials.

Plastics Newsfront

(*Above*) **SUPPLIES FOR THE FIGHTING FRONTS** are shipped to all parts of the world in paperboard containers. Solid fibre and corrugated cases strengthened, made water-resistant and "weather-proofed" with Cyanamid's URAC* Resin Adhesives are being used in increasing numbers for essential civilian as well as military needs.

(*Above*) **DESIGNED TO TAKE PUNISHMENT,** the speedy PT boats of Uncle Sam's Navy combine lightness and strength in construction by the use of plywood bonded modern synthetic resin adhesives. Under the names of URAC and MELMAC, both cold and hot set adhesives are available from Cyanamid to meet specifications for various fabricating conditions.

(*Below*) **ORDERS ARE TRANSMITTED** and received in today's modern warfare via portable "radio jeeps." Weighing less than 10 pounds, these sturdy transceivers, which make extensive use of plastic materials, point the way to new uses for plastics in similar peace-time products of "tomorrow."

OFFICIAL U. S. SIGNAL CORPS PHOTO

(*Below*) **WPB RESTRICTIONS** currently limit use of BEETLE for closures to medicinals and other essential needs. Corrosion resistance, attractive appearance, and adaptability to mass packaging methods have made molded BEETLE caps and closures popular for packaging all types of merchandise from shaving creams to shoe polish.

*Reg. U. S. Pat. Off.

AMERICAN CYANAMID COMPANY

PLASTICS DIVISION

30 ROCKEFELLER PLAZA, NEW YORK, N. Y.

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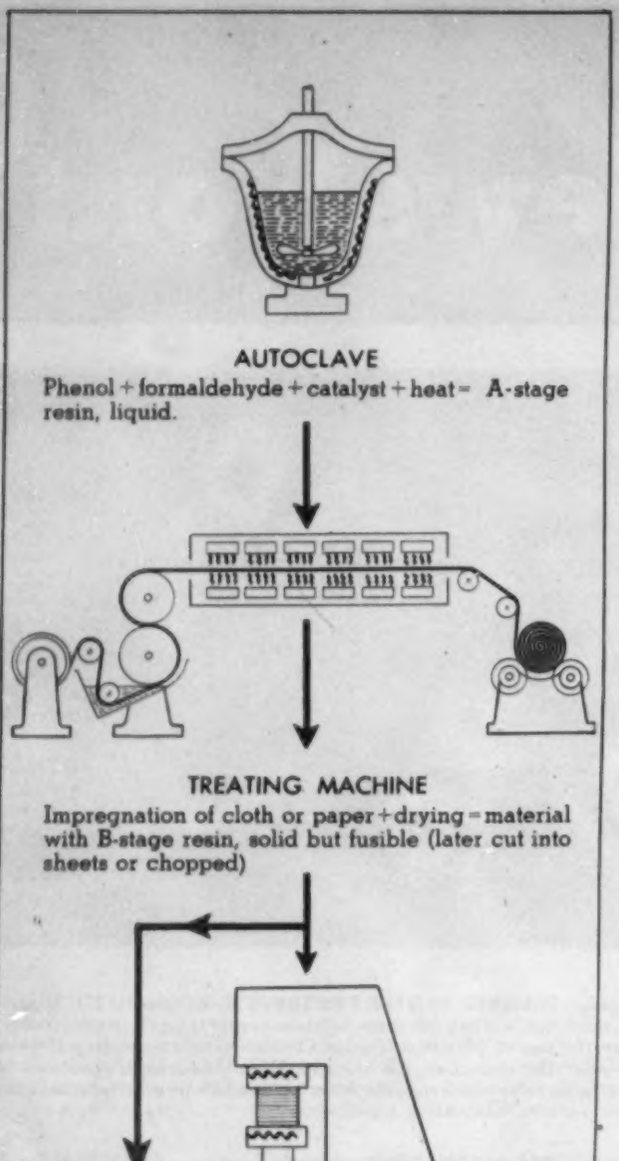

AUTOCLAVE
Phenol + formaldehyde + catalyst + heat = A-stage resin, liquid.
TREATING MACHINE
Impregnation of cloth or paper + drying = material with B-stage resin, solid but fusible (later cut into sheets or chopped)
LAMINATING PRESS
Stack of sheets + pressure + heat = laminated Micarta (C-stage resin, solid, insoluble and infusible)
MOLDING PRESS
Chopped material with B-stage resin + pressure + heat = molded Micarta

ALL DRAWINGS COURTESY WESTINGHOUSE ELECTRIC & MFG. CO.

1—Simplified manufacture flow chart

Chemical resistance of laminates

by C. J. STRAKA*

INDUSTRIAL plastics are playing a prominent rôle in the war effort replacing rubber, bronze, steel, tin and aluminum. Among the toughest and most important of these plastics are the laminates, formed from thin layers of materials such as paper or cloth which are bonded together with synthetic resin of the phenol-formaldehyde type.

Besides toughness, the phenol-resin bonded laminate possesses other desirable characteristics. Mechanically, it has high compressive and flexural strength and the ability to resist high impact forces, and it is light in weight, having a density of only .05 lb. per cubic inch. Its dielectric strength is high, and a $^1/_{16}$-in. piece will withstand 45,000 volts. It is corrosion resistant, not materially affected by acids and alkalies up to 10 percent concentration. Conditions of continued exposure to smog, oils, gasoline or mildly corrosive fumes will not impair its usefulness.

The simplified flow chart, Fig. 1, shows the major steps in phenol-resin laminate manufacture. The operations are closely controlled throughout to provide a uniform product.

Phenol-resin laminates are usually divided into 2 classes:

1. Full laminated or structural forms include such shapes as plates, angles, channels, bearings, rods, tubes and zees. These are formed by bonding sheets of impregnated filler material under heat and pressure.

2. The molded class includes all complicated miscellaneous molded shapes, formed or molded to shape in molds. They are formed from chopped pieces of impregnated filler material bonded under heat and pressure.

Factors which influence chemical resistance

The type of filler used in the manufacture of phenol-resin laminate greatly influences the chemical resistance. The fillers that can be bonded by phenol-resin are cellulose in the form of paper or cloth, asbestos paper or fabric, fiber glass cloth and nylon cloth. Pure cellulose fibers have relatively low resistance to acids but very high resistance to alkalies. However, alkalies have a tendency to cause swelling of the fibers. Asbestos fibers, being alkaline in nature, have poor resistance in the presence of acids but have good resistance in that of alkalies. Glass fibers are unaffected by acids but are easily attacked by alkalies. Nylon fibers have the best chemical resistance of these four fillers, being equally resistant to both acids and alkalies.

Laminates made from absorbent types of fillers—paper, cotton cloth, asbestos paper and asbestos cloth—owe their chemical resistance to the protection of the fibers by the phenol-resin, a protection mainly controlled by the type and amount of resin used. Because of the nature of the structure of paper, it is rather difficult completely to impregnate cellulose or asbestos papers with resin, and consequently they are poorly protected. Cotton and asbestos cloths, on the other hand, can be satisfactorily protected by resin.

The resin used is of the thermosetting class, made by the reaction of phenol with formaldehyde. Various kinds of

* Micarta Engineer, Development Section, Westinghouse Electric and Manufacturing Co.

phenols can be condensed with formaldehyde and many modifications are possible for special use. In general, it is desirable when bonding the absorbent type of filler to select a phenol-resin that will easily impregnate the filler for maximum protection. The function of the phenol-resin in laminates made from non-absorbent fillers—fiber glass cloth and nylon cloth—is for bonding alone. In practice, for non-absorbent fillers, it is customary to use a small amount of a bonding type of resin in conjunction with a corrosion-resistant resin.

In the manufacture of laminates, heat polymerizes the resin to the insoluble and infusible condition. It is desirable that the polymerization be complete, otherwise the laminate will lose some of its corrosion-resistant properties. If the resin is not completely insoluble, chemicals can easily dissolve out the unreacted material.

Mechanical properties of laminates can be varied by the type of weave employed in the construction of a fabric. For instance, maximum strength can be obtained by means of a cord-fabric construction in which the warp threads consist of heavy cords while the filler threads are very small. A laminate made from such a fabric decreases in strength quite rapidly in chemical solutions. Table I shows this effect.

Mechanical properties of laminates, particularly impact, may also be varied by the use of fabrics of different weights. Heavy fabrics generally have high strengths while lightweight fabrics have low strength. In the manufacture of laminates made with heavy fabrics, it is difficult to protect the fibers completely, which results in a sacrifice of chemical resistance.

The chemical resistance of phenol-resin laminates depends on the type, strength and temperature of the chemical solution used. In general, the type of chemical used will have the same kind of effect on the laminate as it has on the filler used, but decreased in an amount equal to the amount of protection produced by the resin. Laminates also decrease in chemical resistance as the concentration of the solution increases. In some cases, certain ranges of concentration have more effect on the material. Table II gives the effect of solution concentration on a medium weave phenol-resin laminate immersed in sulfuric acid and sodium hydroxide solutions. Furthermore, corrosion resistance of laminates decreases with increase of temperature. Above a certain temperature, depending on type of filler used, the laminate may reach a condition where complete failure in a short time is possible.

Chemical resistance of typical laminates

In the past, some data have been published upon the chemical resistance of phenol-resin laminates. H. E. Riley[1] examined the weight and appearance change of a canvas base laminate exposed to widely differing types of concentrations of chemicals and to different temperatures. Tests made according to the A.S.T.M. method for resistance of plastics to chemical reagents, by G. M. Kline and associates,[2] give data for changes in weight, dimensions and appearance for a paper base laminate. The change of shear strength of laminated phenolic paper-base and laminated phenolic glass-base were reported by J. Delmonte.[3] Effect of 10 percent acid at 50° C. on several phenol-resin laminates was shown by V. E. Enz.[4]

Table III lists data obtained by standard A.S.T.M. methods on physical properties of types generally used for chemically resistant applications. Values given are typical averages and variations may be 20 percent lower and 10 percent higher. Figures 2 to 5 show the change in weight and dimensions of a laminate made from a heavy cotton cloth. The great

[1] "Effect of Chemicals on Phenol Resin Bonded Laminated," H. E. Riley, Ind. and Eng. Chem., Vol. 28, 919 (Aug. 1936).

[2] G. M. Kline, R. C. Rinker, and H. F. Meindl, "Resistance of Plastics to Chemical Reagents," Modern Plastics *19*, 59 ff. (Dec. 1941).

[3] "Acid and Alkali Resistance of Plastics," J. Delmonte, Modern Plastics *20*, 91 ff. (Dec. 1942).

[4] "Laminated Plastic Pipe for Chemicals," V. E. Enz, Modern Plastics *19*, 58 ff. (Aug. 1942).

Table I.—Properties of Cord Fabric Laminate

	Strength before immersion	*Strength after 30 days' immersion in 10% acid solution*
Tensile strength, p.s.i.	14,000	6800
Impact strength, ft.-lb./in.	17.4	6.3

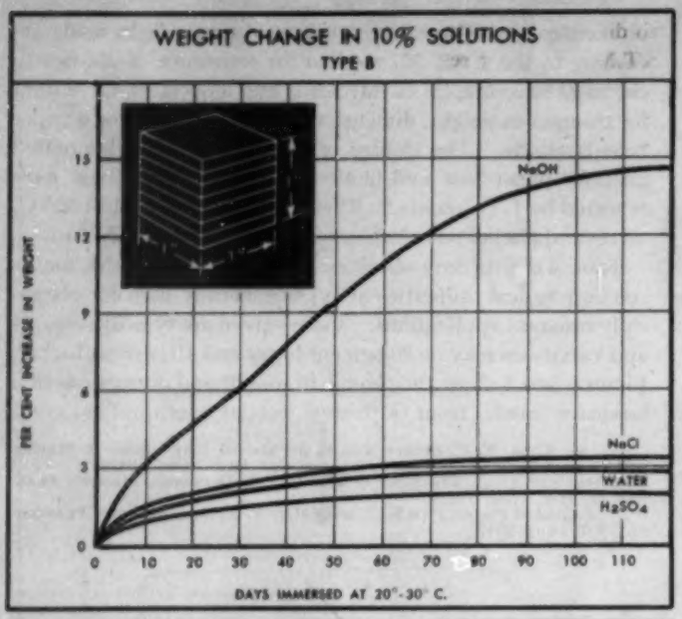
Table II.—Effect of Solution Concentration on Properties of Laminate

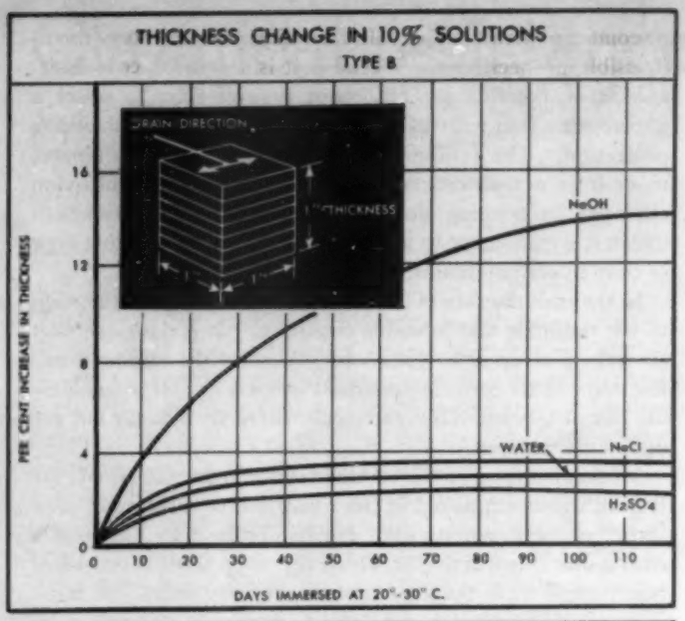
		Change in properties after 30 days' immersion		
Chemical	*Solution concentration*	*Percent weight gain*	*Percent thickness increase*	*Percent decrease in compressive strength*
H_2SO_4	$N/2$	1.75	0.3	14.3
	$3N/2$	1.52	0.3	14.3
	$4N$	1.38	0.2	13.7
	$6N$	1.10	0.2	12.5
	$9N$	0.81	0.1	12.7
NaOH	$N/2$	2.75	0.5	19.7
	$3N/2$	3.88	1.0	21.6
	$4N$	7.81	3.8	30.5
	$6N$	6.45	2.9	22.7
	$9N$	3.64	1.8	11.5

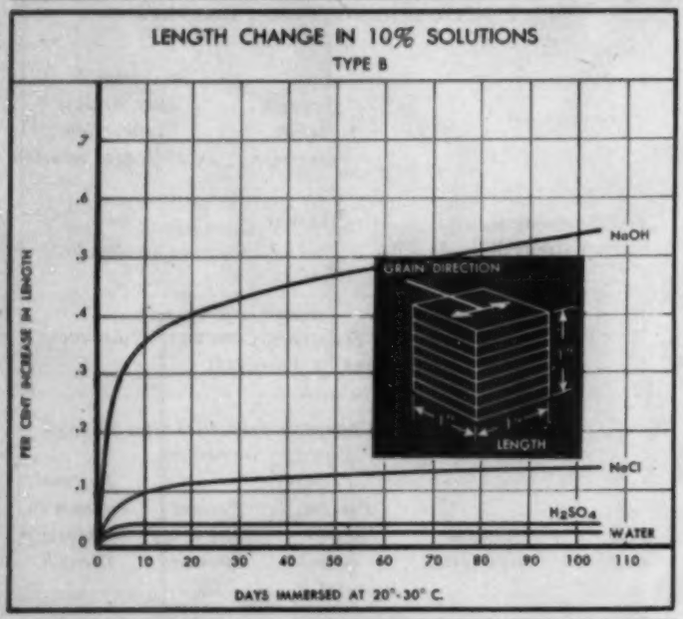
Table III.—Physical Properties of Laminates

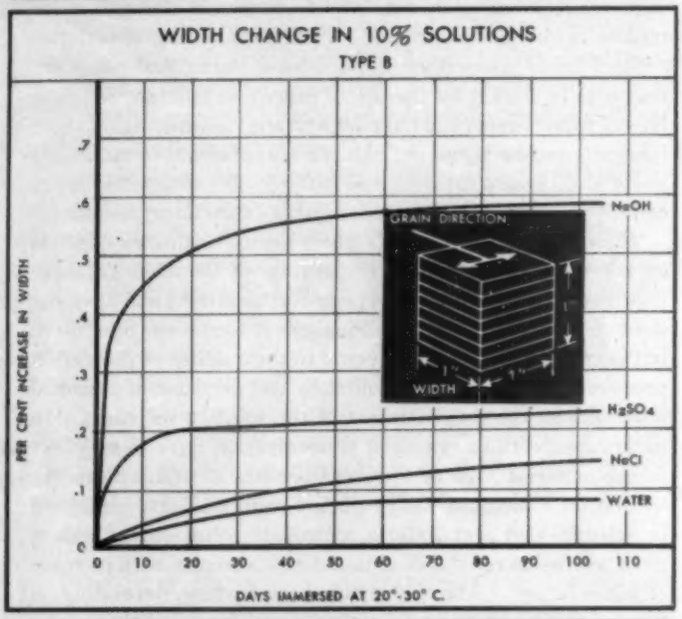
Form	*—Chopped laminated—*		*——————Full laminated——————*				
Filler	*Heavy cotton cloth*	*Fine weave cotton cloth*	*Asbestos fabric*	*Heavy cotton cloth*	*Med. weave cotton cloth*	*Fine weave cotton cloth*	*Fiber glass cloth*
Resin*	R	CR	R	R	CR	CR	BR
Tensile strength, p.s.i.	6,000	5,800	12,000	11,500	9,000	7,000	33,000
Compressive strength, p.s.i.	29,000	30,000	49,000	37,000	36,000	40,000	50,000
Charpy impact strength, ft.-lb./in. width	3.1	1.2	12.0	9.0	6.3	5.1	32.0

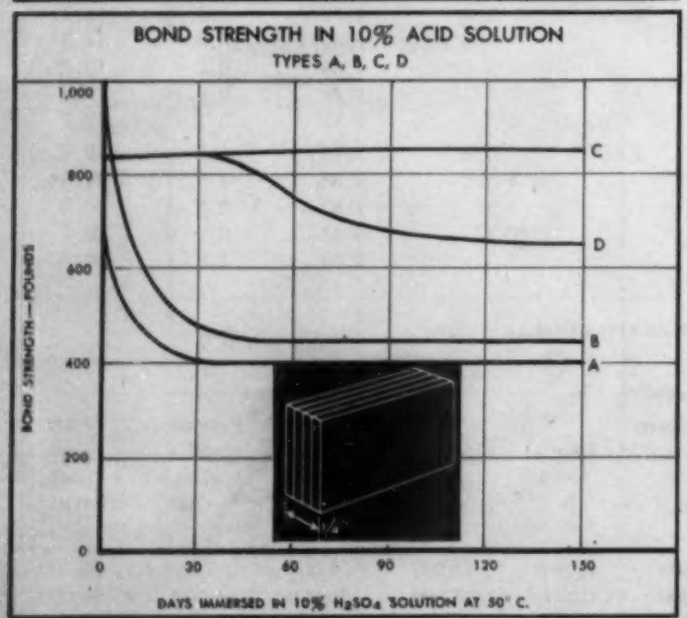
* R = Regular type phenol-resin.
CR = Chemical resistant phenol-resin.
BR = Special resin required for bonding to glass.

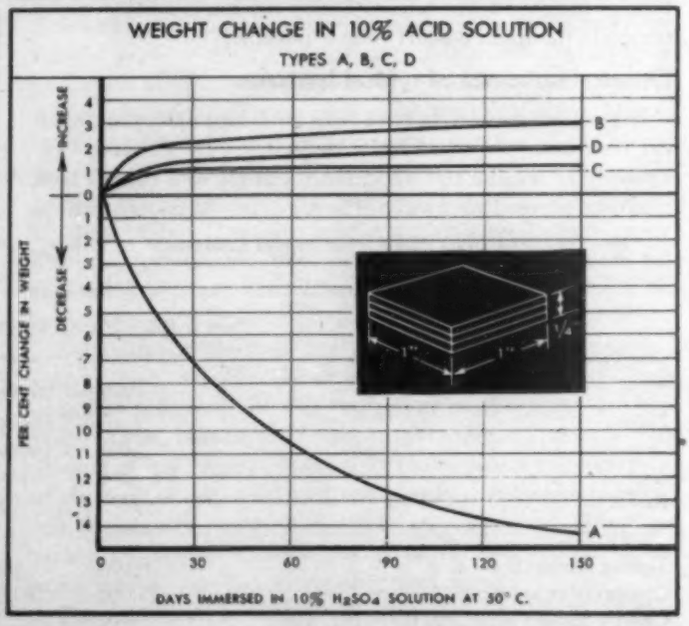




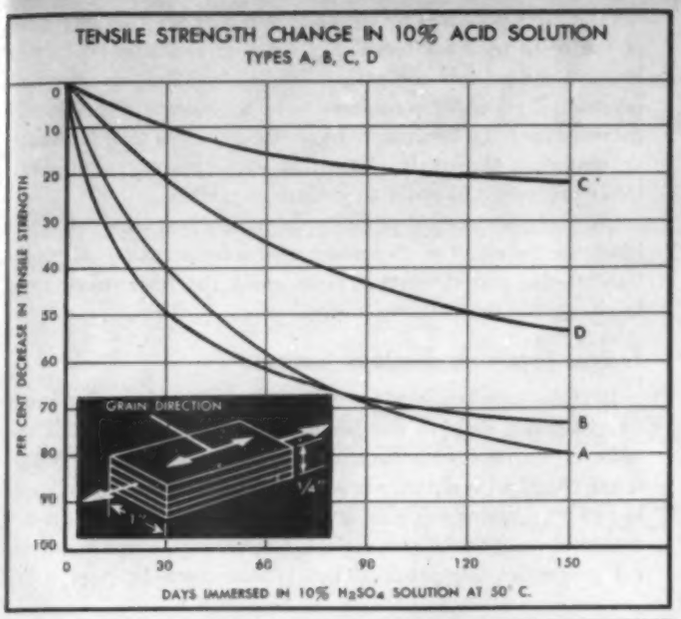


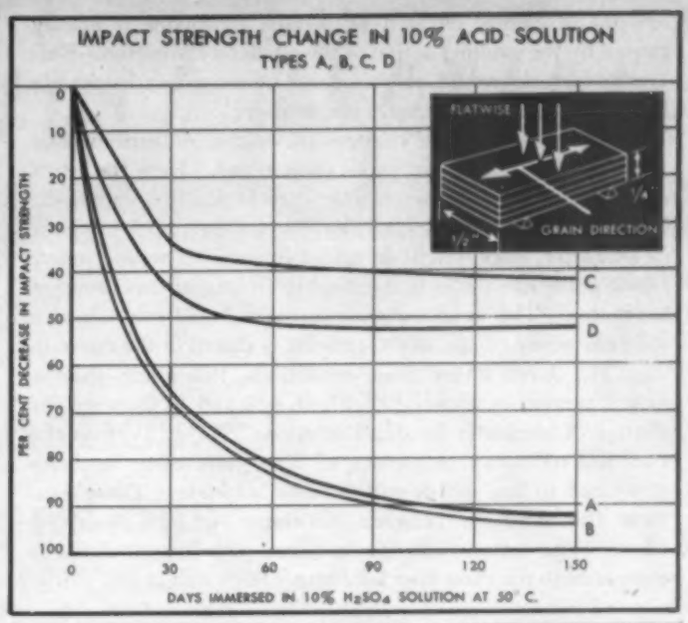


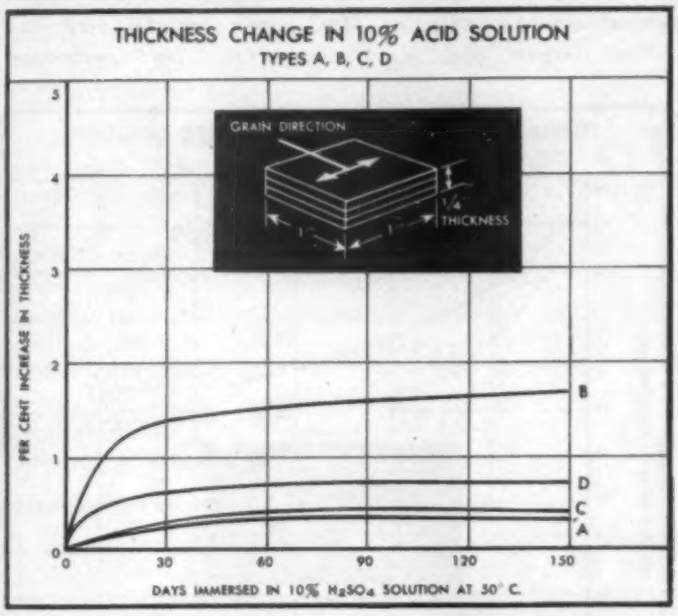


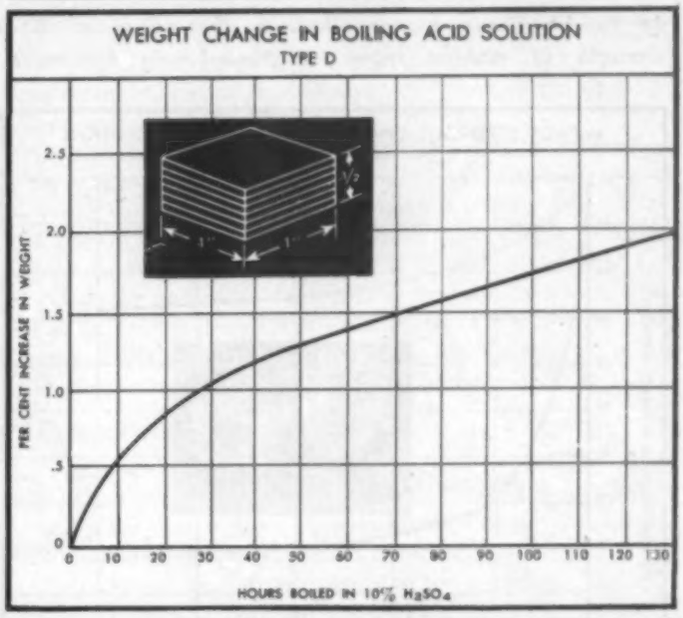


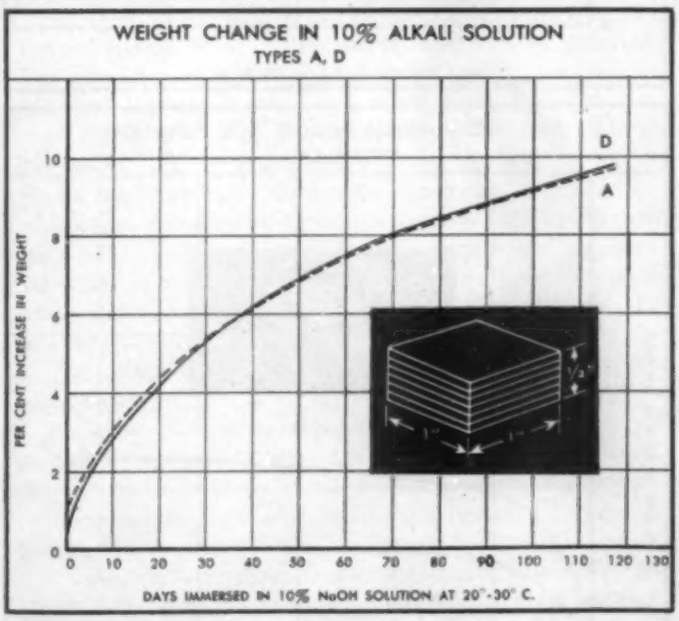
Curves illustrating chemical properties of various grades of laminates. 2 to 5 show weight and dimensional changes of a heavy cotton cloth laminate. 6 and 7 give weight and strength changes for 4 different materials

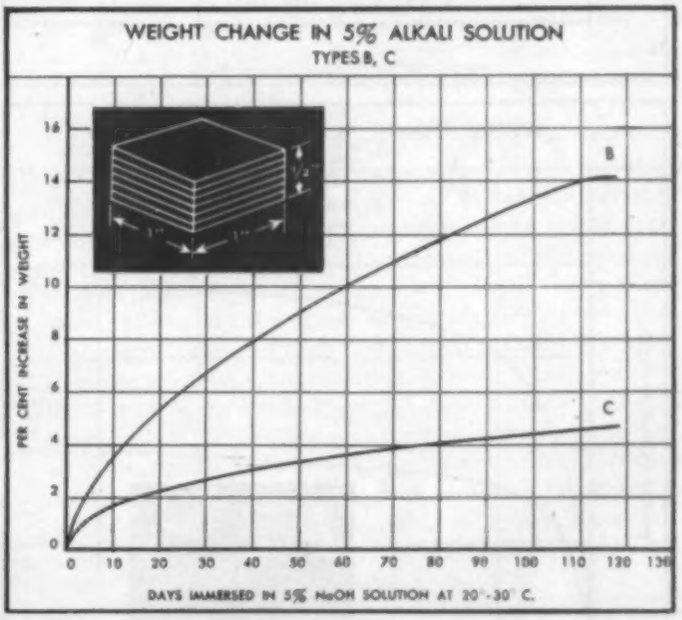












***8** to **10** show changes in strength and dimensions of 4 different types of material. **11** shows weight change of medium weave cotton cloth laminate in boiling acid solution. **12** and **13** show weight change in alkali solution*

amount of change effected by sodium hydroxide is mainly caused by the swelling action of the alkali on the cotton. This type of material would, therefore, not be recommended for use in alkali solutions of such a concentration.

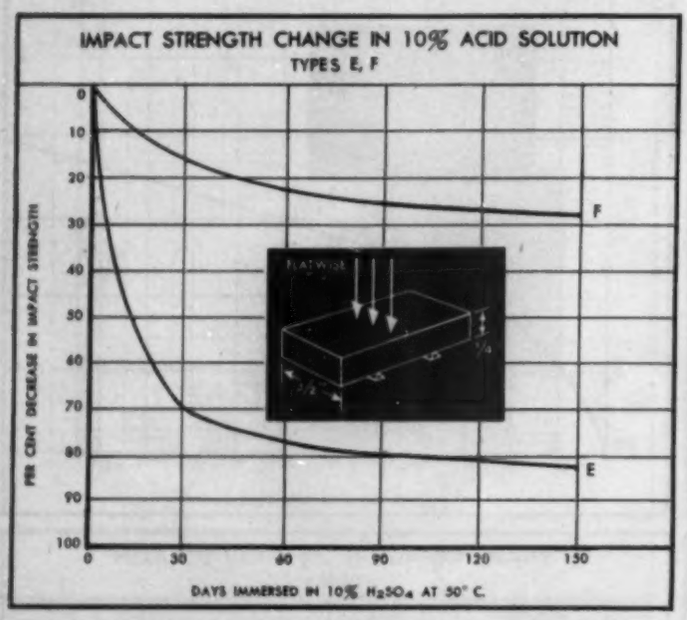
Figures 6 to 10 give changes in weight, dimensions and strength of four different types of material. Here the effect of the weight of fabric used in a laminate is clearly brought out. The asbestos fabric laminate, having a filler that is alkaline in character, loses weight in acid solutions. The fine weave fabric grade has the best chemical resistance of this group of laminates. The weight change in boiling acid solution of a medium weave cotton cloth laminate is shown in the curve in Fig. 11. Even under these conditions, this grade absorbs only 2 percent of its weight. Figures 12 and 13 show weight change of laminates in alkali solutions. Table IV lists the chemical resistance properties of fiber glass cloth laminate compared to fine weave cotton cloth laminate. These data show the difference between absorbent and non-absorbent fillers. The cotton cloth laminate has poor impact strength compared to the glass fiber laminate. High weight and thickness changes obtained by the glass laminate are characteristic of the resin used for bonding. Another important point is brought out in this comparison: weight change in chemical solutions is generally considered to be a measure of the chemical resistance of a laminate. In the case of glass fiber laminate or materials similar in nature, it is necessary to measure other properties in order to get a true picture.

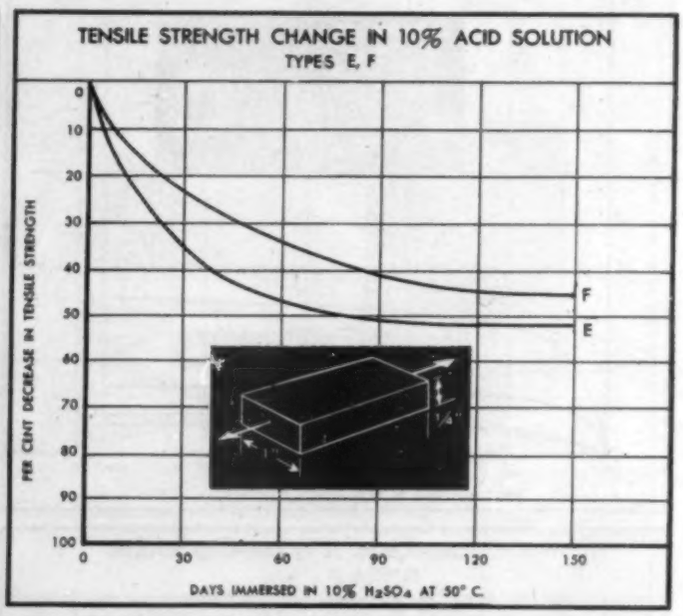
For molded types of phenol-resin laminates, Figs. 14 to 17 illustrate the effect of 10 percent acid solution at 50° C. upon weight, size and strength. Here again the fine weave type laminate has the best resistance.

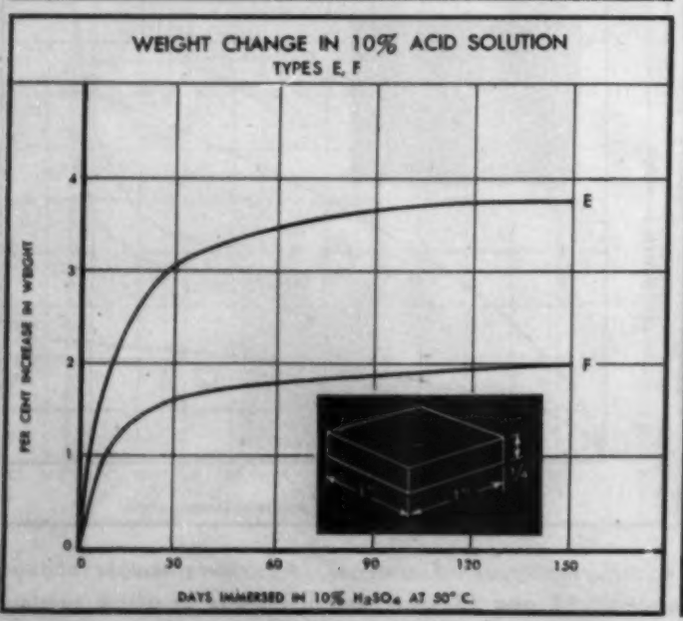
Factors governing choice of laminate

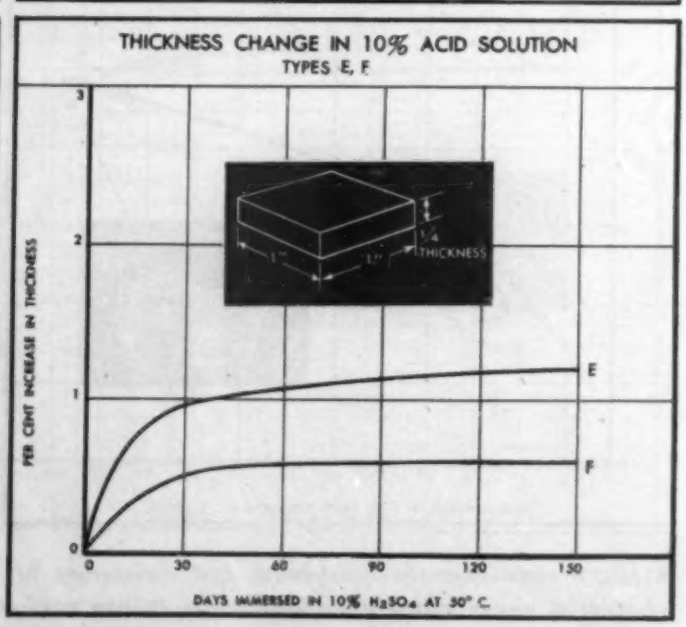
In choosing a laminate for chemical use, consideration must be given not only to the corrosion resisting qualities of the material but to its mechanical characteristics as well. Maximum chemical resistance is obtained for cellulose-filler laminated by a high resin content which, however, causes a decrease in mechanical properties. Conversely, extreme physical properties are attained by (*Please turn to page 136*)

14 to 17—*These curves illustrate the effect of 10 percent acid solution at 50°C. upon weight, size and strength of molded types of phenol-resin laminates. Fine weave type again shows the best resistance*









Impact testing of plastics—
I: Energy considerations*

by DAVID TELFAIR** and HOWARD K. NASON**

Summary

"Impact strength" values obtained by the standard Izod and Charpy test methods do not reliably indicate the behavior of a plastic part when subjected to impact stresses in service, nor do they accurately rank different plastic materials with respect to their ability to resist fracture when exposed to such stresses. An analysis of the energy relationships in these tests accounts for some of the discrepancies, and a modified test, which measures the energy required to just initiate fracture in a test specimen, is proposed. The results obtained by this modified test rank materials in order of their known shock-resisting qualities, and correlate well with service experience.

Introduction†

The shock-resisting properties of organic plastics have been evaluated on low-capacity pendulum instruments of the Charpy and Izod types for at least 20 years. The present A.S.T.M. Standard method D 256-41T was originally intended for comparing electrical insulating materials of generally similar composition and physical characteristics, and no one can deny that the test has been of value for this purpose.

However, during the last decade, diversified expansion of the industry has made available a greatly increased variety of plastic materials and, for a number of reasons, including simplicity and cheapness of apparatus, rapidity with which data may be obtained, apparent ease of operation and apparent reliability of results, the standard impact test has been widely adopted for control, inspection, specification and research testing of these materials.

The pendulum type of test possesses two fundamental disadvantages:

1. Test values must be obtained on a standard specimen and can be compared only on the basis of that standard specimen; they cannot be referred to other sections, have no absolute physical significance and cannot be utilized in design calculations.[1]

2. Impact test values do not measure the true energy required to fracture the specimen nor do they reliably indicate relative shock resistance of materials which differ markedly in composition or mechanical properties.[2]

Solutions to the first objection have recently been published by Callender (5), who proposes a method for obtaining impact values which are valid for specimens of any section, and by Koon (6), who proposes a method for calculating a "modulus of impact" from standard A.S.T.M. impact test results.

It is the purpose of this paper to describe the results of research into the second disadvantage and to propose a modified impact test which will afford a more reliable measure of the shock-resistance of present-day plastic materials.[3]

Physical considerations

An analysis of the standard A.S.T.M. impact test shows that the value reported as "energy to break" the specimen is really the sum of the energies consumed by several mechanisms. The more important of these are:

1. Energy to initiate fracture of the specimen.
2. Energy to propagate the fracture across the specimen.
3. Energy to plastically deform the specimen.
4. Energy to throw the broken ends of the test specimen.
5. Energy lost through vibration of the apparatus and its base, and through friction.

In a brittle material, the tearing energy will be very small relative to the fracture energy, whereas in a tough, ductile or fiber-filled material tearing energy may be very large relative to fracture energy. The notch, which is always present in the standard test specimen, serves to concentrate the stress and largely prevents plastic deformation; hence, energy consumed in plastic deformation is insignificant in most cases. The energy absorbed by the thrown ends of the broken specimen may represent a large fraction of the total energy used in the test (5, 8, 9), especially in the case of brittle materials. Energy losses due to vibration of the apparatus may be large in testing metals (10), but are apparently negligible for the standard plastics test (1). Friction losses are largely eliminated by careful design and operation of the apparatus (11).

The investigation herein reported was undertaken to evalu-

* This paper was presented at the annual meeting of the American Society for Testing Materials in Pittsburgh, Penna., on July 1, and is published here by permission of that Society.

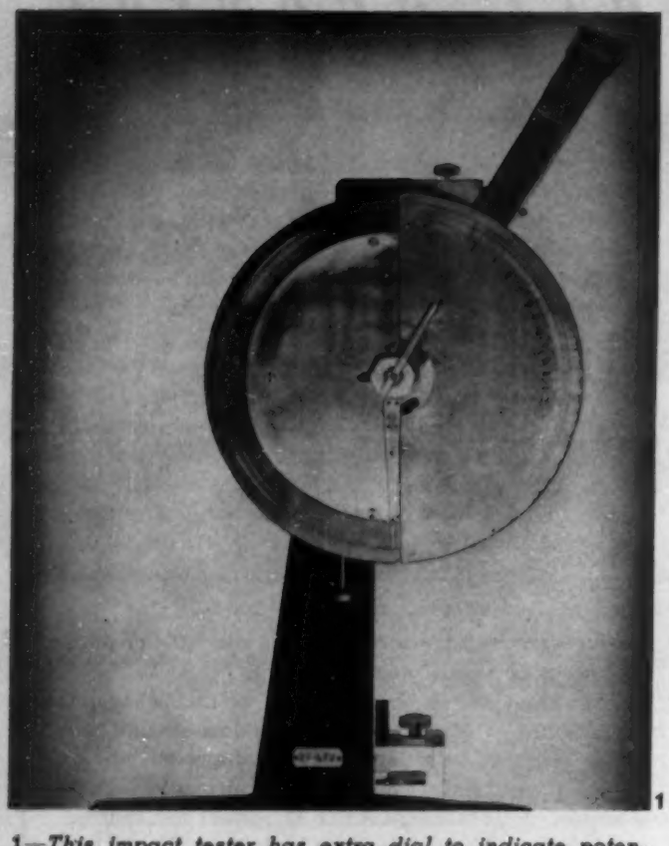
** Research Dept., Plastics Div., Monsanto Chemical Co.

† Numbers in parentheses in this paper refer to references cited in the Bibliography.

[1] This fact has been realized from the inception, many years ago, of work on impact testing in A.S.T.M. Committee D-9 (1, 2, 3, 16).

[2] This, also, has been pointed out repeatedly (4).

[3] Callender, whose researches were published after most of our experimental work was completed, accomplishes a similar result by the application of similar physical reasoning, and we are glad to acknowledge his contribution to the field. Both of us, however, were anticipated by Church and Daynes (7), whose work on Ebonite came to our attention only recently and was also overlooked by Callender until after his work was completed. Although Church and Daynes used a different experimental technic, their method of analysis is remarkably like ours, and is shown by our results to apply well to a wide range of plastic materials. We acknowledge, without question, their priority of thought in this field.



1—*This impact tester has extra dial to indicate potential pendulum energy at any desired initial elevation*

ate the magnitude of the above energies, and to clear up some of the inconsistencies observed when testing plastics of different composition by the standard impact test. For example, a phenolic composition containing mica or asbestos filler has a greater impact strength, as determined by the A.S.T.M. test, than does one containing woodflour, although the former is known from its behavior in fabrication and service to be considerably less shock-resistant.

Just as the usefulness of a part in service is essentially ended by a static load which stresses it beyond its yield value, so is its capacity for further service destroyed by a shock load of sufficient magnitude to produce cracking. Hence, it seemed reasonable to consider cracking as a criterion of failure, and to determine the impact energy required to just crack a specimen.[4] This was done by a modification of the standard Izod test, in which the initial elevation of the hammer was varied so as to vary the kinetic energy available at the moment of impact.

Experimental testing procedures

The standard impact apparatus was provided with an auxiliary dial which indicates the potential energy of the pendulum at any desired initial elevation (Fig. 1). Thus, the reaction of the specimen to blows of any desired kinetic energy could be studied. Best results were obtained by a statistical energy-to-fracture (ETF) method, in which several groups of specimens were subjected to single-blow impacts of predetermined energy, and the fraction of the specimens in each group showing a) a barely discernible fracture and b) a complete break was plotted as a function of the energy of the blow.

An illustrative example is shown in Fig. 2. From these curves the following information may be obtained:

1. Shocks of less than 0.083 ft.-lb. per in. of notch will crack none of the specimens (*A* in Fig. 2).

2. Shocks of greater than 0.125 ft.-lb. per in. of notch will crack all of the specimens (*B* in Fig. 2).

3. Shocks of less than 0.095 ft.-lb. per in. of notch will break none of the specimens completely but may crack some of them if above 0.083 ft.-lb. per in. of notch (*C* in Fig. 2).

4. Shocks of greater than 0.16 ft.-lb. per in. of notch will completely break all of the specimens (*D* in Fig. 2).

5. Shocks of 0.106 ft.-lb. per in. of notch will crack half of the specimens (*E* in Fig. 2). This value may be considered to be the statistical mean energy-to-fracture (ETF).

6. Shocks of 0.142 ft.-lb. per in. of notch will completely break half of the specimens (*F* in Fig. 2). This may be considered to be the statistical mean energy-to-break (ETB).

7. The difference between ETB and ETF, in this case 0.036 ft.-lb. per in. of notch, is probably a measure of the energy consumed in completing the fracture, i.e., tearing off the broken piece.

8. The difference between the shock which will fracture none of the specimens (*A*) and that which will fracture all of them (*B*), or between the shock which will break none of the specimens (*C*) and that which will break all of them (*D*), is an indication of the homogeneity of the test material. If this difference is large, i.e., the values have a high degree of scatter, material is relatively non-homogeneous, and vice versa.

The statistical method is not convenient for routine testing because it is relatively time consuming and requires a large number of samples. Hence, two other tests to measure the energy required to just break a specimen were devised. The first of these, the small-excess-swing (SES) test, resembles the standard A.S.T.M. impact test except that initial hammer elevations are so chosen that the kinetic energy at impact is barely in excess of that required to break the specimen. The small amount of "follow-through" of the hammer is noted and this residual energy subtracted from the initial potential energy setting to give the energy consumed in breaking the specimen. The value includes the energy required to initiate fracture, and to tear the specimen in two, but minimizes losses due to thrown fragments.

In the second, the increasing blow (IB) method, the specimen is struck from an energy level slightly below that required to fracture, and the process is repeated from levels increasing by about 10 percent until fracture occurs. Values by this method are usually slightly lower than those of the statistical ETF method because of fatigue effects. (Both ETF and ETB values, as determined by the statistical method, are free from any fatigue effects.)

An estimate of the energy required to throw the broken

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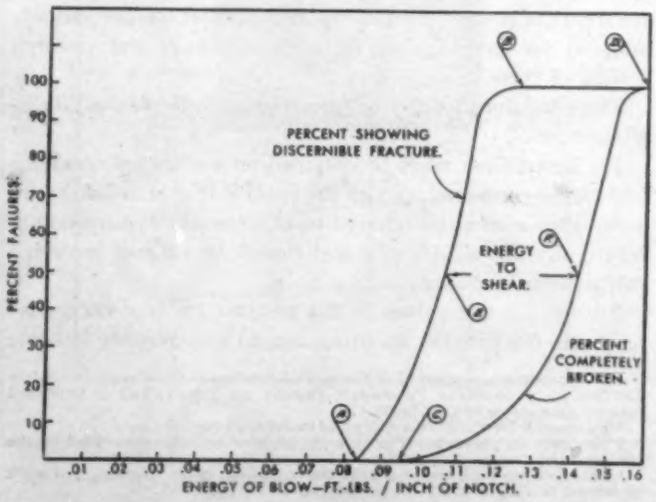

[4] This has been proposed previously by Mains (12).

TABLE I.—IMPACT STRENGTHS OF VARIOUS PLASTICS AS DETERMINED BY SEVERAL METHODS
(All energy values are in ft.-lb. per in. of notch)

Test method	Molded phenolic compositions: Woodflour filler	Molded phenolic compositions: Asbestos filler	Molded phenolic compositions: Chopped canvas filler	Polystyrene: Injection-molded	Polystyrene: Cast	Polymethyl methacrylate: Cast
Standard Izod						
Total energy	0.263 ± 0.012	0.265 ± 0.007	2.94 ± 0.24	0.305 ± 0.070	...	.....
Energy to throw broken end	0.190 ± 0.004	0.235 ± 0.006	0.139 ± 0.008	0.152 ± 0.008	...	.....
Statistical						
To crack (ETF)						
None	0.083	0.050	0.85	0.13	0.100	0.115
Half	0.105	0.059	1.07	0.18	0.165	0.133
All	0.124	0.070	1.70	0.25	0.250	0.157
To break (ETB)						
None	0.095	0.065	1.30	0.25	0.100	0.115
Half	0.143	0.074	1.60	0.31	0.165	0.133
All	0.155	0.110	2.20	0.35	0.250	0.157
Increasing-blow (IB)	0.099 ± 0.004	0.060 ± 0.003	1.419 ± 0.057	ca. 0.44	...	.....
Small-excess-swing (SES)	0.134 ± 0.005	0.082 ± 0.006	2.77 ± 0.35	0.227 ± 0.05	...	0.147 ± 0.009

specimen in the standard Izod test was obtained by replacing the fragments and noting the energy consumed in kicking them away by a second blow of the pendulum. This estimate may be inaccurate, as pointed out by Werring (9) and Zinzow (8), where the coefficients of restitution of the materials being studied differ appreciably, but for our tests the results seemed to be reasonably correct.

Experimental results

Four molded phenolic compositions (containing woodflour, chopped canvas, cotton cord and a mixture of asbestos and woodflour fillers, respectively), two polystyrenes (one cast and one injection-molded) and cast polymethyl methacrylate were studied. Standard 0.5 × 0.5 in. bars, notched by milling (A.S.T.M. D 256-41T) were used. The phenolics were preconditioned at 50° C. for 48 hrs. and stored in a desiccator until tested (A.S.T.M. D 618-41T, Type S). The polystyrene and polymethyl methacrylate samples were conditioned and tested at 25° C. and 50 percent relative humidity (A.S.T.M. D 618-41T, Type R).

Figure 2 shows the results for the woodflour-filled phenolic. Similar curves were prepared for the other materials tested and the data obtained therefrom are summarized in Table I. Figure 3 shows the results for asbestos-filled phenolic, cast and injection-molded polystyrene and cast polymethyl methacrylate. Results for fabric-filled phenolic are shown in Fig. 4. It will be noted that the various data on energy to fracture correlate much better with toughness of the materials, as deduced from practical experience, than do the standard Izod data. Specifically, the asbestos-filled formulation is shown to be more brittle than that containing woodflour, as is known from empirical experience to be the case. The effect of density of the specimen, which adds so materially to the "broken end" error, is eliminated. Similarly, the comparative strengths of fabric-filled and woodflour-filled formulations more nearly approach those which service experience would lead us to expect, as do those of polystyrene and woodflour-filled phenolic. The comparative homogeneities of these materials, estimated as outlined above, are also worth noting.

Estimation of the energy to fracture has proved especially valuable during an investigation of the effect of continued heating on the strength of thermosetting plastics, and enabled several puzzling effects to be resolved rationally. For example, Fig. 5 shows the effect of continued heating at 200°

These graphs show the effect of single impact blow on: **2**—*standard Izod specimens of woodflour-filled phenolic plastic;* **3**—*standard Izod specimens of various plastics;* **4**—*standard Izod specimens of fabric-filled phenolic plastic*

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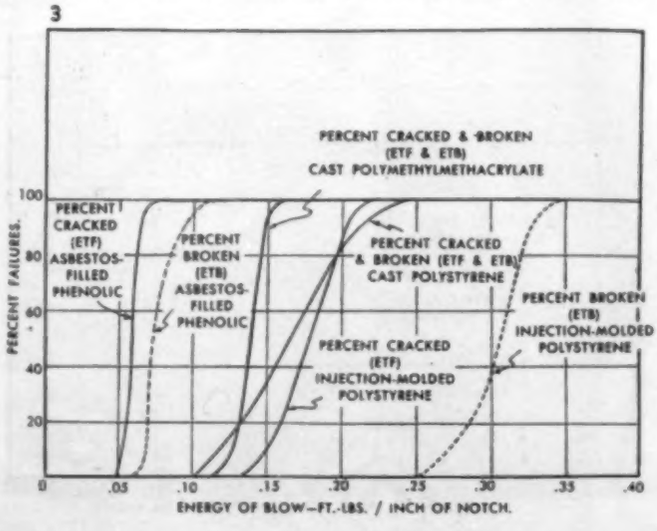

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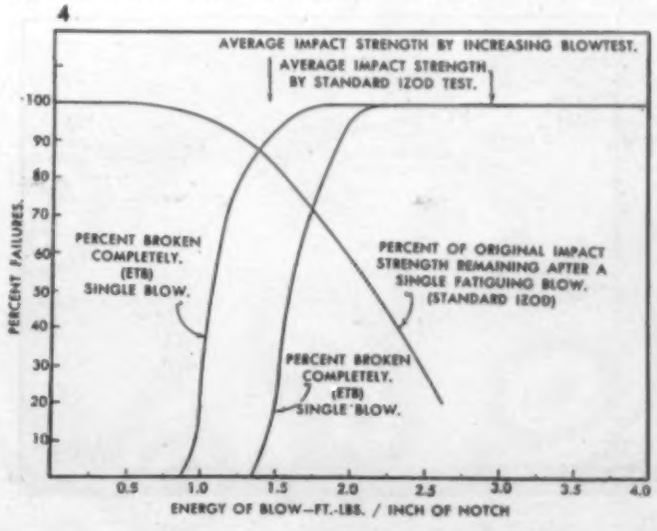

C. (392° F.) on the impact strength, as measured by the standard Izod test and by the increasing blow energy-to-fracture test, of a phenolic resin composition containing cotton cord as a filler. It will be noted that the resistance to cracking decreases exponentially with time of heating, whereas the resistance to breaking in the standard Izod test is complicated by the fact that the energy used in tearing shows an initial resistance to heat but breaks down with increasing speed as heating continues. Both values finally approach the strength of resin alone, as the reinforcing action of the cellulosic filler is destroyed by thermal decomposition.

The "fatigue" effect of single or multiple impact blows whose force is insufficient to fracture the test specimen can be estimated by another modification of this test. In this, specimens are struck by a blow (or blows) of any desired energy content and are then broken by any of the proposed methods (the small-excess-swing procedure is especially suitable). The "residual" strength of the specimen, after the fatiguing impacts, is then plotted, in percentage of the strength of similar specimens broken in a single blow, as a function of the energy level from which the fatiguing blow was struck. Figure 6 shows such data for an asbestos-filled phenolic composition, for cast and injection-molded polystyrene, and for cast polymethyl methacrylate, using the small-excess-swing test, and Fig. 4 shows similar information for a fabric-filled composition obtained by the standard Izod method. Single fatigue blows were used in both cases.

The data for cast and injection-molded polystyrene, and for cast polymethyl methacrylate are remarkable in that they show a negative fatigue effect, similar to the work-hardening of metals, when struck by blows whose energy is less than 80 percent of that required to cause fracture. It may be that blows of lesser intensity cause enough plastic flow at the base of the notch to reduce the stress concentration factor during the subsequent fatal impact.

Conclusions and acknowledgment

The results outlined above are, of course, limited in scope. They do seem to be sufficiently interesting, however, to justify further investigation of tests of this type. In the method we have employed, the velocity of the impact hammer must vary as the kinetic energy is varied. This is undesirable since the importance of fixing the velocity and varying only the available energy is known (1, 5, 7, 13, 14, 15). The falling-weight method employed by Callender and by Church and Daynes offers a promising solution to this problem, and should be investigated in detail, using a greater number of types of plastics. Fatigue effects should be evaluated, using many blows of low energy content (Callender's ingenious device for insuring uniform speed with such low-energy impacts should be of value for this purpose). Callender's method for relating impact strength to specimen cross section appears to be of great practical importance and should be studied in detail. The investigation of these points is recommended to the A.S.T.M. Committee D-20 on Plastics.

W. C. Davis was responsible, at least in part, for the early development of these ideas, and assisted with the early laboratory tests. R. K. Swank contributed greatly to the investigation and performed most of the experimental work on the phenolic resin compositions. R. A. Klucken furnished samples and data from his work on the effect of continued heating on the properties of phenolics. J. E. Westberg and J. H. Watt assisted with some of the tests.

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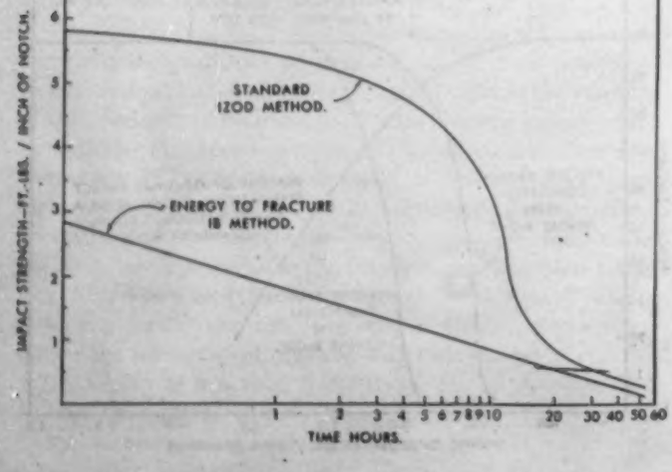
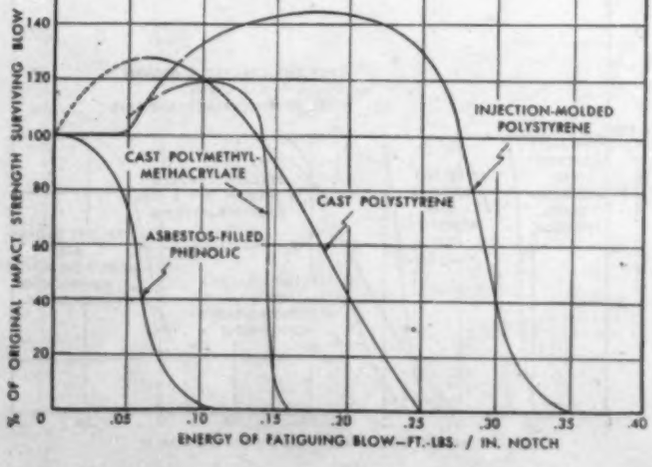
***5**—Impact strength of cotton-cord-filled phenolic at 200°C.*



***6**—Effect of single fatiguing blow on impact strength*



Aircraft applications of plastics*

by LT. C. L. FELL†

TODAY we wish to announce the successful completion of the flight tests of the first all-plastic airplane. This ship, of semi-monocoque construction, first took to the air on December 7, and has since been flown in accelerated service test for the equivalent of one year's service flying.

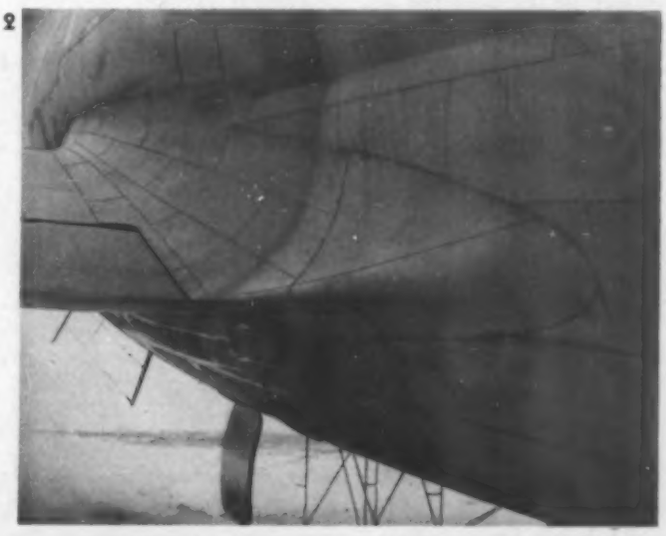
This is the typical newspaper story that has stirred the public's imagination for several years, and first started the development projects now engaged in the search for a truly synthetic plastic material from which to make airplanes. Needless to say, the material referred to was the conventional plywood which has been used for years, but with the substitution of a synthetic resin for the older casein and blood glues. With the typical reaction, though, the public has seized upon these stories and built dream airplanes turned out with mass production speed from rows of molds. The inherent advantages of plastic materials in performance as a result of their low density and supposedly high strengths have been bases for development programs in progress for the past three years.

With the initiation of work on plastic materials, there quickly came realization that there was no plastic material available for structural parts, and that the available data on existing materials were of little use in airplane design. From this base, the plastic projects in the air services have grown to their present position. Today, although the possibility of designing an efficient plastic airplane is not a reality, the progressive development programs have uncovered materials that we are reasonably certain have a future in the aircraft ndustry as a primary structural material.

Before proceeding further, it would be well to define a few terms as applied to airplane structures by the industry. Each part of the airplane can be classified under one of three general headings: primary structure, secondary structure and non-structural parts.

Primary structures are the load-carrying units of the airplane, and the failure of any such structure would result in failure of the airplane. Examples of these structures would be the wings, the fuselage or the tail surfaces. Secondary structures do not contribute to the load-carrying ability of the airplane, but may carry air loads. The failure of a part coming under this classification would endanger the satisfactory operation of the airplane. A stub wing tip, fillets or side panels would be secondary structures. With the basic air frame now defined, there remains the interior, most of which can be classed as non-structural. Any part under this class would contribute nothing to the load-carrying ability of the airplane, and its failure would have no effect, other than accidental, on the performance. Under this broad classification would come interior doors, lavatory facilities, tables, map cases, and many other such items.

Preliminary investigations having failed to uncover a plastic material which would measure up to the minimum requirements for primary structures, work was started on the application of existing materials to secondary and non-structural parts. Coincident with this work, research was initiated to determine where the material then in use could



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Use of low-pressure molding permits application of plastics to such secondary structural airplane parts as fairings (Figure 1), fillets (Figure 2), bomber tail cones (Figure 3)

* Paper presented at the ANC-Industry Conference, sponsored by the Army-Navy-Civil Technical Subcommittee on Plastics, held in Philadelphia on Feb. 9, 1943.

† Air Corps, Aircraft Laboratory, Wright Field.

be modified to produce a suitable structural material and, if this were impossible, to develop a new material possessed of the required properties.

The design of any secondary or non-structural part is usually dictated by production and economic considerations rather than any strength criteria. Airplane construction has always been a limited quantity production problem. Many parts of ships have been handmade and fitted to place in order to save the high costs of die making. One of the big reasons for the superiority of American designs has been the fluid status of each model. Hitler froze his designs for mass production and the results are beginning to become apparent today as the German airplanes come up against American models incorporating the latest design modifications. This type of aircraft production, carried many times right up to the moment of battle, has largely precluded any attempt at mass production of even non-structural parts in the quantities of conventional plastic molding procedures. The production of 100 or 200 parts might constitute the total output from a large, expensive, high-pressure die. Economically, the investment in high-pressure molding equipment can be justified only by high production demands or, in wartime, the serious criticalness of certain materials.

In the interests of more rapid and still economical production, attention has centered on low-pressure curing resins which can be formed over relatively cheap molds. With such molds, it is possible to quickly make the changes dictated by the designers and at the same time maintain economical production.

Standardization of non-structural parts has made great strides in the past few years. Here is probably the only opportunity for actual mass production of plastic parts. Under this come such parts as the control wheels, control knobs, data cases, map cases and like articles. Many of these are molded from thermoplastics.

Numerous applications are now being made of standard commercial grade laminates. The use of sheet for control wire rubbing blocks is familiar. Not too well known is the ammunition box for the P-40 and P-39 airplanes. This is an example of direct substitution to relieve a shortage of stainless steel. In these boxes, commercial grade C laminates are assembled with piano hinges and cellulose acetate butyrate rollers. This box is now a simple assembly job because the new design was built for production. Cooperation between the services and the manufacturer made the box perform satisfactorily after early models had been failing in service.

From the flat sheet, it is only a short jump to the fabrication of trim tabs and possibly flaps such as the outer wing flap on the BT-15. These parts are molded to the proper aerodynamic shapes by wrapping the resin-impregnated cloth on a split-formed mandrel, and covering in a properly shaped mold. The resultant shape is aerodynamically correct and uniformity is insured. The trim tabs and flaps have been static and fatigue tested with excellent results. The parts probably should be stronger than comparable built-up units due to the one-piece construction which molds the spars integrally with the skin, and the advantage of reinforcing by varying section thicknesses at will. Only the fittings have to be attached for the finished product.

An interesting non-structural part is the one-piece molded data case. In this, the hinges are not cured, a feature which gives an attached cover with the elimination of the critical metal hinges. This one-piece data case was also a relatively low-pressure molding operation.

A point to note on many secondary and non-structural parts considered for substitution is the procedure involved in the metal assembly design. Most of these parts are not designed for any requirements but are the result of long-standing practices. For this reason, the weight and design of such a part are not the best possible.

Progressing to secondary structural parts, the most important examples are fillets and fairings. Here, more than in any other application, the (*Please turn to page 128*)

4

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Examples of secondary structural airplane parts made by the high-pressure molding of phenolic laminate are the life raft container (Figure 4), the gunner door (Figure 5), and the escape hatch for a heavy bomber (Figure 6)

Plastics from redwoods*

by HARRY F. LEWIS†

IN THEIR far-reaching program for conserving waste from redwood, the Pacific Lumber Co. of Scotia, Calif., initiated a long-term research project at the Institute of Paper Chemistry. As the first step in the project, the Institute's staff carried out an intensive study of the chemical and physical components making up the redwood tree. A careful botanical study of the bark was carried out by a wood technologist. A fiber microscopist measured the length and width of the various types of fibrous materials, both in bark and wood. Analytical chemists analyzed wood from various places in the tree, such as sapwood, heartwood, old and new stumps and roots. These data are summarized in Tables I to IV. Determinations of extractive content were carried out on sections over 15 to 20 ft. all the way up the tree trunk. A plant chemist studied the extractives in needles, twigs and cones of the redwood.

Following this fundamental investigation, application studies were then set up in the various fields where the specific properties might find application. These included tanning, antioxidants, flotation agents, antiseptics, insect sprays, destructive distillation, hydrogenation, medicinal uses, textiles, pulping and many other lines. As a result, they have acquired a wealth of fundamental and applied knowledge which has led to commercial applications in several fields. The particular application study to be described here is that of the redwood plastics.

Redwood flour

Redwood, as such, in the form of woodflour is thermoplastic. It may be molded directly without any added material to give a product which resembles in appearance an article molded out of the conventional thermosetting molding powders. Due to poor flow characteristics and the fact that the product is not particularly water resistant, molding redwood flour alone is not a commercial operation. Low flow means high pressure for molding; about 5000 p.s.i. and 320° F. are required to produce a small disk. The degree of flow and nature of the product is related to the extractive content. The sapwood cannot be made into a molded article of any interest. Roots, on the other hand, give a somewhat more interesting product.

Redwood flour can be improved in its molding characteristics by adding plasticizers which improve flow, such as glycerol to the extent of 10 percent. An additional improvement is noted when a hardener such as hexamethylene-tetramine is added. Under these conditions, it is possible to mold an article which is both strong and water-repellent. Test pieces have been made which have the following characteristics:

Impact strength, Charpy unnotched, ft.-lb./in. width	1.0
Tensile strength, p.s.i.	6,450
Flexural strength, p.s.i.	10,400

The molding powder had the following composition:

	%
Redwood flour	91.5
Glycerol	3
Hexa	5
Condensation black	0.5

It was molded at 4000 to 5000 p.s.i. and 320° F. The big disadvantage is the great pressure required for molding.

Redwood flour has a second use in plastics as an extender for the scarce phenol-formaldehyde resins. However, this use is not particularly satisfactory since the products lack the water resistance of the ordinary phenolic molding compounds. It may be considered, however, as an emergency use.

A molding powder of this type has been made from redwood flour and a phenolic resin in accordance with the following formulation:

	%
Stumpwood flour	74
Durez 114	25
Calcium stearate	0.5
Carbon black	0.5

The ingredients were mixed for 90 min., milled for 1¼ min. at 210–240° F., and then ground. The molding powder was preheated for 2 min. at 212° F. The material can be molded at 4000 p.s.i. and 310° F. for 5 minutes. It is thermosetting and can be used in conventional molds. Its strength values in comparison with a commercial phenolic molding compound are as follows:

	Palco 198	Bakelite *3200*
Impact strength, Charpy unnotched, ft.-lb./in. width	0.55–0.60	0.61
Tensile strength, p.s.i.	5300	6520
Flexural strength, p.s.i.	7500	8560
Water absorption (24 hr.), %	2.5	0.5
Molded specific gravity	1.37	1.356

Curing at 300° F. for 2 hours gives better impact strength and water resistance.

Redwood plastic pulps

A second point of attack on the problem of utilizing of redwood wastes for plastic purposes has been based upon the discovery that when redwood wastes are cooked with steam at high pressure, the tannins and phlobaphenes are modified and combined with modified wood substance to yield a pulp which is much superior to redwood flour as a base for further plastic operations. The pulp when molded at 4000 p.s.i. and 300° F. has the following physical characteristics:

Impact strength, Charpy unnotched, ft.-lb./in. width	0.58
Tensile strength, p.s.i.	5480
Flexural strength, p.s.i.	7700–8000
Water absorption (24 hr.), %	2.5–3.0

This pulp has several disadvantages when used alone. One is that it is partially thermoplastic and the molds must be cooled from the molding temperature of 300° F. to approximately 250° F. to eject the piece. A second is that the

* Abridged from a paper presented before the Wood Industries Div. at the spring meeting of the American Society of Mechanical Engineers in Davenport, Iowa, on April 26–28, 1943, and published here through the courtesy of that Society.

† Institute of Paper Chemistry.

TABLE I.—COMPOSITION OF EXTRACTIVE-FREE REDWOOD

Source of material	Lignin	Pentosans	Cellulose (Cross & Bevan)	Polyuronides	Cellulose/lignin
Sapwood	33.8	12.9	56.0	4.0	1.65
Heartwood	36.4	12.0	53.4	3.9	1.46
Green stumps	37.4	9.9	53.3	2.7	1.42
Old stumps	37.3	10.7	52.4	3.8	1.40
Roots	37.6	8.4	55.4	3.2	1.47

TABLE II.—DISTRIBUTION OF ALCOHOL-BENZENE AND HOT WATER SOLUBLES IN REDWOOD

Solvent	Amount of material extracted from: Sapwood	Lumber	Stumps	Roots
	%	%	%	%
Alcohol-benzene	1.6	7.3	16.3	28.9
Hot water	2.8	7.5	12.9	17.8

TABLE III.—RELATIVE AMOUNTS OF EXTRACTIVES AND EXTRACTIVE-FREE RESIDUES IN REDWOOD

	Heartwood	Stumps	Roots
	%	%	%
Extractives	10.2	20.1	32.3
Extractive-free residue	89.8	79.9	67.7

TABLE IV.—DISTRIBUTION OF ALCOHOL-SOLUBLE COMPONENTS OF REDWOOD CALCULATED TO ORIGINAL BONE DRY WOOD

Source of material	Alcohol extract	Phlobaphenes	Tannins	Cycloses	Reducing sugar
	%	%	%	%	%
Sapwood	1.9	0.7	0.2	...	...
Heartwood	13.2	6.2	4.1	1.3	0.3
Green stumps	15.8	7.6	4.1	2.2	1.0
Old stumps	13.0	3.2	3.8	1.9	0.7
Roots	32.0	22.1	7.8	...	1.1

TABLE V.—PROPERTIES OF PLASTICS FROM REDWOOD FLOUR

Material	Extractives	Impact strength, Charpy unnotched	Tensile strength	Flexural strength
	%	ft.-lb./in. width	p.s.i.	p.s.i.
Stump—Old	21.7	0.56	4900	8,140
New	17.7	0.57	5670	8,700
Root—Old	22.0	0.57	5420	8,500
New	22.7	0.57	5200	8,900
Stump[a]—New	....	1.0	6450	10,400
Stump[b]—New	....	0.55–0.60	5300	7,500

[a] Composition: 91.5% redwood flour, 5% hexa, 3% glycerol, 0.5% condensation black.
[b] Composition: 74% redwood flour, 25% phenolic resin (Durez 114), 0.5% calcium stearate, 0.5% carbon black.

product swells and becomes sticky when exposed at elevated humidities due to the presence of resins which are still somewhat water soluble. Nevertheless, alone or mixed with a small amount of lignin or Vinsol, a product results which has good flow and finish and not too bad physical characteristics. A molding composition made of 95 percent plastic pulp and 5 percent Meadol (alkali lignin made by the Mead Corp.) has the following characteristics:

Impact strength, Charpy unnotched, ft.-lb./in. width	0.45
Tensile strength, p.s.i.	6700
Flexural strength, p.s.i.	8000
Water absorption (24 hr.), %	2.0–2.5

Many articles have been molded from the 95-5 basic formulation, as for example, cameras and spools. The composition has the advantage of being cheap and available in large tonnage without the use of any critical materials. Nevertheless, the thermoplastic characteristics of redwood pulp would hold the ready utilization of the formula down to emergency uses.

Thermosetting molding compositions

This leads to the third phase of the research, namely, the production of thermosetting molding formulations. It will be necessary to be somewhat less than frank in covering all the details of this development since patent coverage is not yet completed. The thermosetting molding powder now achieved is the result of a series of interesting chemical reactions. The first involved the conversion of the tannins and phlobaphenes in the redwood to a resinous composition with the normal wood chemicals, the result of a cooking operation. The second was the discovery that these could be further condensed up to the stage of thermosetting materials with a resinous material developed at the Institute of Paper Chemistry. This resinous material is the result of a polymerization of a by-product condensed in turn with formaldehyde. The resin and redwood plastic pulp are then condensed together by milling in the presence of a catalyst to the desired point at which they will polymerize in the mold to yield the finished product under manufacturing conditions. Bottle caps have been made from this composition on commercial machines under the same conditions of time and pressure used with the conventional molding powders. The product has the following physical characteristics:

Impact strength, Charpy unnotched, ft.-lb./in. width	0.37–0.40
Tensile strength, p.s.i.	5000
Flexural strength, p.s.i.	6500
Water absorption (24 hr.), %	1.0

It will be seen that the strength values are not quite so high as those for the straight pulp, but the increase in resistance to water (and incidentally to acids) makes it much more interesting for commercial use, and its conversion to a thermosetting product means that conventional molds can be used.

(*Please turn to page 134*)

TABLE VI.—PROPERTIES OF PLASTICS FROM REDWOOD PLASTIC PULP

Material	Extractives	Impact strength, Charpy unnotched	Tensile	Flexural	Water absorption, 24 hr. test (A.S.T.M. D 570-42T)
	%	ft.-lb./in. width	p.s.i.	p.s.i.	%
Pulp alone	30	0.58	5480	7700–8000	2.5–3.0
Pulp 95%, Meadol 5%	..	0.45	6700	8000	2.0–2.5
Thermosetting pulp molding powder	..	0.37–0.40	5000	6500	1.0

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Meeting of A.S.T.M. Committee D-20

THE annual meeting of the American Society for Testing Materials held in Pittsburgh, Penna., June 28 to July 2, was the occasion for concluding action by the Society on several additional testing methods and specifications for plastics and the presentation of important technical papers by members of Committee D-20 on Plastics. These latter included the following: "Relaxation of Rubber-Like Materials," by Irving L. Hopkins, Bell Telephone Laboratories, Inc.; "Deformation under Load of Rigid Plastics" by Robert Burns, Bell Telephone Laboratories, Inc.; "Impact Testing of Plastics. I. Energy Considerations," by D. Telfair and H. K. Nason, Monsanto Chemical Co.; and "The Relation between Repeated Blow Impact Tests and Fatigue Tests," by Wm. N. Findley, University of Illinois, and O. E. Hintz, Radio Corp. of America. These papers will be published in the Technical Section of MODERN PLASTICS by permission of the A.S.T.M. as space permits (see page 85).

Another paper of interest to the plastics industry which was on the program of the Pittsburgh meeting was the Eighteenth Edgar Marburg Lecture entitled "Wood as an Engineering Material," delivered by L. J. Markwardt of the Forest Products Laboratory. This was a summary of research accomplishments pertaining to the use of wood as a structural material, both in its natural form and in various modified forms, achieved through the use of synthetic resin glues and impregnants.

Committee D-20 has sponsored a special compilation of "A.S.T.M. Standards on Plastics" which contains all of the specifications and test methods developed by the Committee and approved by the Society prior to this meeting. It includes in addition a number of related standards prepared by several other A.S.T.M. committees that are of interest in the testing of plastics (see page 108).

Activities of subcommittees

Subcommittee I on Strength Properties (M. H. Bigelow, chairman) has developed Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D 256 – 41 T) (prepared jointly with Committee D-9 on Electrical Insulating Materials), Tensile Properties (D 638 – 42 T), Compressive Strength (D 695 – 42 T), and Flexural Stress (Fatigue) Test of Plastics (D 671 – 42 T).

A Method of Test for Shear Strength has been completed and recommended for publication as tentative.

Under study are tests for determining impact strength, tensile properties, and compressive strength at high and low temperatures, tests for determining the strength properties of nonrigid plastics, test for tensile properties of thin sheet material, test for flexural strength, and test for bearing strength and impact strength at high speed or under load.

Subcommittee II on Hardness Properties (L. Boor, chairman) has developed Tentative Methods of Test for Deformation Under Load (D 621 – 41 T) and Mar Resistance (D 673 – 42 T), also a Recommended Practice for Long-Time Tension Tests (D 674 – 42 T).

This subcommittee has under consideration methods of test for Rockwell hardness, scratch resistance, creep, wear resistance of bearings, and coefficient of friction.

Subcommittee III on Thermal Properties (W. A. Zinzow, chairman) has developed Tentative Methods of Test for Flammability of Plastics 0.050 In. and under in Thickness (D 568 – 41 T) and Plastics over 0.050 In. in Thickness (D 635 – 41 T), Flow Temperatures of Thermoplastic Molding Materials (D 569 – 41 T) and Coefficient of Linear Thermal Expansion (D 696 – 42 T).

A Method of Test for Measuring Relative Mobility of Thermosetting Molding Powder has been completed and recommended for publication as tentative.

Under consideration are methods of test for cubical expansion, rate of burning at high temperatures (glo-bar test) and a simplified procedure for determining heat distortion.

Subcommittee IV on Optical Properties (W. F. Bartoe, chairman) has developed Standard Methods of Test for Index of Refraction (D 542 – 42), Tentative Methods of Test for Diffusion of Light by Plastics (D 636 – 41 T), Surface Irregularities of Flat Transparent Sheet (D 637 – 41 T), and Haze of Transparent Plastics by Photoelectric Cell (D 672 – 42 T), and Descriptive Nomenclature of Objects Made from Plastics (D 675 – 43 T).

Under consideration is work relative to optical clarity, transmission and reflectance, and associated characteristics of plastics.

Subcommittee V on Permanence Properties (J. H. Teeple, chairman) has developed the Standard Method of Test for Water Absorption (D 570 – 42) (prepared jointly with Committee D-9 on Electrical Insulating Materials), and Tentative Methods of Test for Resistance to Chemical Reagents (D 543 – 41 T), Colorfastness of Plastics to Light (D 620 – 41 T), Water Vapor Permeability (D 697 – 42 T) and Conditioning Plastics and Electrical Insulating Materials for Testing (D 618 – 41 T) (prepared jointly with Committee D-9).

A Method of Test for Resistance of Plastics or Plastic Parts to Extreme Service Conditions has been completed and recommended for publication as tentative.

Under consideration are tests for accelerated weathering, permanent effect of heat and semi-permanent effect of heat on plastics.

Subcommittee VI on Specifications (G. M. Kline, chairman) has completed ten new tentative specifications for various types of plastics, the titles and designations of which are as follows: Phenolic Molding Compounds (D 700 – 43 T), Cellulose Nitrate (Pyroxylin) Plastic Sheets, Rods and Tubes (D 701 – 43 T), Cast Methacrylate Plastics (D 702 – 43 T), Polystyrene Molding Compounds (D 703 – 43 T), Melamine-Formaldehyde Molding Compounds (D 704 – 43 T), Urea-Formaldehyde Molding Compounds (D 705 – 43 T), Cellulose Acetate Molding Compounds (D 706 – 43 T), Cellulose Acetate Butyrate Molding Compounds (D 707 – 43 T), Rigid Sheets made from Vinyl Chloride-Acetate Resins (D 708 – 43 T) and Laminated Thermosetting Materials (D 709 – 43 T).

Specifications for Vinyl Chloride-Acetate and Vinylidene Chloride Molding Compounds have been completed and recommended for publication as tentative.

The subcommittee has also prepared specifications for the following molding compounds which will shortly be submitted to the Society for publication as tentative: Nonrigid Polyvinyl Chloride Acetate, Nonrigid Polyvinyl Butyral, Nonrigid Polyvinyl Chloride, and (*Please turn to page 132*)

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TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments

Engineering

STANDARD TOLERANCES OF PHENOLIC AND UREA MOLDINGS. M. Freund. British Plastics *14*, 683–6 (Apr. 1943). Five different proposals for tolerance limits on moldings are discussed. A standardized system of tolerances is proposed. The limits are in relation to the size of the molding. The tolerances are different according to whether the dimensions are fixed in one or more tool parts. The tolerance is affected by the type of powder used and by the number of cavities in the tool. Tables of tolerances are given for three groups of dimensions: those lying within one tool part, those contained in two tool parts in the direction of molding, and those contained in two tool parts other than in the direction of molding (splits).

BEHAVIOR OF GLAZING MATERIAL SUBJECTED TO EXPLOSION F. W. Adams. ASTM Bulletin No. 122, 15–23 (May 1943). The effect of bomb explosions on glass and other glazing materials was determined by detonating charges of dynamite at specified distances from a window in a small frame test house. Results are summarized for tests on usual glasses, glass treated with anti-scattering materials, safety glasses, glass blocks, plastics, plywood and fabricated boards.

JOINING LIGHT ALLOYS WITH ADHESIVES. Plastics *7*, 216–18 (May 1943). Brief details are given of the use of Redux, a synthetic resin adhesive developed by Aero Research, Ltd., for bonding metal to metal and metal to wood. Unaffected by water, oil or gasoline, the material works best with trivalent metals such as aluminum, chromium and iron or steel. It gives less satisfactory joints with brass, tin or zinc. The resin bond is mildly thermoplastic and loses strength above 100° C. The apparent shear stress at room temperature for a bonded 6-gauge duralumin joint is 5300 p.s.i. For the gauges commonly used in aircraft, the failing stress exceeds 2000 p.s.i. at temperatures up to 70° C.

HIGH-FREQUENCY ELECTRIC-FIELD HEATING FOR NON-METALLIC MATERIALS. T. R. Olive. Chem. & Met. Eng. *50*, 102–4 (Apr. 1943). The high-frequency electric field method of heating non-metallic materials is described in detail and data given regarding operation. The application in the manufacture of resin-bonded plywood, impregnated compressed wood laminates, molding and curing of plastics, and rubber and paper drying is discussed.

Chemistry

INDIRECT PHENOL-ALDEHYDE CONDENSATIONS. J. B. Niederl and J. S. McCoy. J. Am. Chem. Soc. *65*, 629–31 (Apr. 1943). When *o,o'*-dimethylol-*p*-cresol, a completely blocked phenol, was condensed with phenols having two ortho positions available for condensation, such as *p*-cresol and *p*-bromphenol, high-melting crystalline condensation products resulted, the acetates of which analyzed for a 2:2 condensation and not for a 2:1 condensation as previously suggested. For purposes of comparison, a 2:1 condensation product was actually formed by condensing the same phenolic dialcohol with a blocked phenol, 2,4-xylenol, unable to undergo cyclization. The linear condensation product thus prepared was a low-melting amorphous solid. Thus, the analytical evidence presented does not support Koebner's postulations that phenol-aldehyde condensation products are of the linear type only. The lower-melting or fusible types appear to possess a linear structure, while for the high-melting or non-fusible types, a cyclic structure appears to be in better harmony with actual analytical findings.

CHEMISTRY OF HEAT POLYMERIZATION OF STYRENE. J. W. Breitenbach and H. L. Breitenbach. Z. phys. Chem. A, *190*, 361–74 (June 1942). The effect of *p*-benzoquinone and chloranil on the heat of polymerization of styrene was investigated. The velocity of polymerization is reduced and the average chain length of the polymers produced is smaller. A chemical reaction occurs between the quinone and the styrene which impedes the growth of the chain.

Properties

THE PERMEABILITY OF TRANSPARENT WRAPPINGS. C. R. Oswin. J. Soc. Chem. Ind. *62*, 45–8 (Apr. 1943). Measurements of the permeability of transparent wrappings are discussed, and figures for average moisture-vapor permeabilities at 39° C. are given: 0.27 g./m.²/day/mm. of Hg aqueous vapor pressure for "moistureproof" cellulose film, 1.02 for rubber hydrochloride, 4.1 for cellulose nitrate, 17.4 for cellulose acetate, 3.7 for waxed glassine and 1.0 for yellow waxed paper. The individual values are naturally distributed, and fall on a straight line when plotted on logarithmic-probability graph paper. Figures are given for the permeability of seams, joints, etc., and it is shown how to assess the overall permeability of a package and to predict its safe shelf-life according to the contents. Data on the permeability of these materials to hydrogen, helium, air, carbon dioxide and ammonia are also given.

COLD BONDING TESTS. Aviation *42*, 209–11 (May 1943). Plywood and block shear test data are given in tabular form. The materials were bonded with a cold-setting urea-formaldehyde resin glue. With double spreading, the average shear strength with dry birch specimens was 365 p.s.i. with 25 percent wood failure for the plywood, and 3096 p.s.i. with 92 percent wood failure for the blocks; with wet specimens, the average shear strength for the plywood was 319 p.s.i. with 8 percent wood failure. With single spreading, the average shear strengths were 389 p.s.i. with 49 percent wood failure, 2868 p.s.i. with 92 percent wood failure, and 308 p.s.i. with 12 percent wood failure, respectively. Qualitative data are given for various woods bonded at pressures varying from 0.33 to 200 p.s.i.

THE INFLUENCE OF TEMPERATURE ON THE STRENGTH OF PLASTICS. II. IMPACT STRENGTH AT HIGH AND LOW TEMPERATURES. R. Nitsche and E. Salewski. Kunststoffe *31*, 381–8 (1941). Results of impact strength tests made on 26 plastics at temperatures between −70° and 200° C. are reported. The conditioned specimens were maintained at the test temperature by spraying with a liquid at that temperature. The influence of temperature on impact strength is most marked in the cellulose derivatives. In non-laminated materials the type of impact strength-temperature curve depends on the filler. Laminated materials increase in impact strength up to 80° C., above which the strength decreases. There is a marked temperature effect above 0° C. in the polyvinyl chloride and vinyl chloride acetate copolymer. There is no obvious relationship between the impact strength-temperature curves and the indentation hardness-temperature curves.

Testing

OSMOTIC PRESSURES OF POLYVINYL CHLORIDE SOLUTIONS BY A DYNAMIC METHOD. R. M. Fuoss and D. J. Mead. J. Phys. Chem. *47*, 59–70 (Jan. 1943). A dynamic osmometer suitable for materials dissolved in organic solvents is described. Directions are given for the preparation of membranes from partially denitrated cellulose nitrate. The osmotic pressures of a series of concentrations, 2 to 10 g. of polymer per kg. of solution, of fractionated vinyl chloride polymers in methyl amyl ketone at 27° C. are reported. The molecular weight of a carefully fractionated sample determined osmometrically checks the value obtained for the same polymer by means of the ultracentrifuge. Also, the osmometric values for other fractions of the same original polydisperse polymer check viscometric values, using the first polymer as a calibrating substance for the viscometer method.

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This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals mentioned directly to publishers

General

EDUCATION IN THE WORLD OF PLASTICS. V. E. Yarsley. Brit. Plastics *14*, 648–51, 730–2–4–6–7 (Apr., May 1943). A comprehensive survey and discussion of the development of educational facilities in Great Britain in the field of plastics. The subject is considered under three main headings: industrial training, cultural training and school and home craft instruction. Reference is made to the article in the August 1942 issue of MODERN PLASTICS, page 60, for "an excellent survey of what America is doing for education in plastics." The value of public exhibitions of plastic materials and products is stressed.

SCOPE OF PLASTICS IN AUTOMOBILE ENGINEERING. D. Warburton Brown. Plastics *7*, 201–8 (May 1943). The automotive uses of plastics are considered under three main headings: engine unit, chassis unit and body and fitments. The wealth of data regarding the physical properties of plastics and their behavior under alternating stresses made available during the war period will enable engineers to use these materials in the postwar car to advantage. In addition to these extensive engineering data, new materials have emerged and improved manufacturing techniques have been perfected which the designer can consider in planning for the postwar automobile.

PLASTICS PRACTICALLY SPEAKING. R. F. Marshall. Architectural Record *93*, 54–9, 86 (April 1943). Attention is focused in this article on the end products—plastics which can be employed in building construction and equipment. Many practical questions concerning plastics and their uses are answered. The author foresees hundreds of applications for plastics in construction when the imagination and design skill of the architect and engineer are harnessed to the technical knowledge of the plastics producer.

PLASTICS PROSPECTS. M. G. Milliken. Can. Chem. and Process Ind. *27*, 260, 262 (May 1943). A general discussion of the various types of commercial plastics. Some of the newer materials such as nylon, allyl resins, butadiene polymers and copolymers and silicone resins are included. New developments are stressed, particularly of ethyl cellulose and cellulose acetate.

Materials

SYNTHETIC RUBBER. A SURVEY OF ITS PAST, PRESENT, AND FUTURE. H. L. Fisher. Chem. and Eng. News *21*, 741–50 (May 25, 1943). The present synthetic rubber program is described. A brief history, types and properties, prices, processing, compounding and applications of synthetic rubber, emulsion polymerization, sources of basic substances and copolymerization are described and discussed.

VINYL RESINS IN WAR AND PEACE. R. B. Akin. Chem. Ind. *52*, 457–60, 599–603 (Apr., May 1943). The history of the vinyl resins is briefly outlined. The syntheses, chemical structures, chemical and physical properties and applications of vinyl resins are discussed. The vinyl resins discussed include polyvinyl chloride, polyvinyl acetate, vinyl chloride-vinyl acetate copolymers, polyvinyl alcohol, polyvinyl formal, polyvinyl acetal, polyvinyl butyral and polyvinylidene chloride. A table of trade names, including the foreign, of vinyl resins is given. Seventy-six references are given.

GAP-FILLING GLUES. Brit. Plastics *14*, 656, 691 (Apr. 1943). The cause of crazing of urea-formaldehyde glues is briefly discussed. Development of a hardener which evaporates more rapidly than water, so that the process of hardening proceeds without the production of residual strains, is reported. The hardener, known as GB9 originally and now available in three types designated as GBM, GBP and GBQ, is a development of Aero Research, Ltd.

Applications

APPLICATION OF VINYL RESINS AND PLASTICS TO TEXTILES. C. W. Patton. Am. Dyestuff Rep. *32*, 124–7, 133 (Mar. 15, 1943). Several applications of vinyl-resin-textile combinations are described. These include pontoons, shoe toes, shoe uppers, truck, supply and equipment covers, food packages, water bags, upholstering materials, hospital sheeting, raincoats and protective covers for workers in chemical plants. The use of vinyl resin for making fabrics more water-resistant and as adhesives in fabric applications are also discussed.

SYNTHETIC RESIN PLASTICS FOR BEARINGS IN SCREW CONVEYORS. F. Bechtold. Brit. Plastics *14*, 640–44 (Apr. 1943). Tests conducted at screw conveyor plants for five years have proved that the lining of intermediate bearings with bushes made of fabric-base laminate yielded a remarkable reduction in wear as compared with the formerly used bearings of cast iron and red bronze. It is recommended that the length of the bush should not exceed its diameter and that hardened bearing journals be used. The plastic bearings were successful even at 350° to 425°F.

PHENOL RESINS AND RESIN EMULSIONS AND THEIR APPLICATION TO TEXTILES. W. H. Butler. Am. Dyestuff Rep. *32*, 128–33 (Mar. 15, 1943). The application of phenolic resins and resin emulsions to textiles is discussed. The products are used for hospital sheeting, laundry roll covers, backing for surgical tape, weather resistant tape, industrial pressure-sensitive adhesives, empire and cable cloth and where heat-, chemical- and solvent-resistant fabrics are needed.

HEAT SEALING AGENTS, THEIR APPLICATION AND EVALUATION. F. S. Leinbach. Modern Packaging *16*, 85–8, 108, 110 (May 1943). The types of heat sealing agents which can be formed into packaging material or coated upon packaging material are described. The coating materials are of two kinds, those which melt and those which become sticky upon heating. Waxed paper is the best known and most widely used of the first kind. Cellulose nitrate containing adhesive resins blended with it is the most common of the latter kind. Other agents which lend themselves to heat sealing are ethyl cellulose, cyclicized rubber, cellulose acetate, cellulose mixed esters and various vinyl resins.

Coatings

DURABILITY OF LUSTERLESS ENAMEL. S. E. Beck. Ind. Eng. Chem. *35*, 594–5 (May 1943). Two series of lusterless olive drab enamels were prepared: the extender or extender combination was varied in one series, and the volume of pigment in the total solids in the other series. The extenders included asbestine, calcium carbonate, diatomaceous silica, barytes, silica, slate flour, water ground mica and china clay. The vehicle was an alkyd resin. Steel panels coated with the enamels were exposed out of doors for one year. Results indicate that all of the extenders studied are satisfactory and that pigment volumes exceeding 60 percent of the total solids cause failure by fading and chalking. Calcium carbonate gave the best results as regards color retention and chalking resistance.

THE FINISHING OF ARMY DUCKS WITH SPECIAL REFERENCE TO MILDEWPROOFING. E. C. Bertolet. Am. Dyestuff Rep. *32*, 214–19, 226–7 (May 10, 1943). The production of fire-, water- and weather-resistant ducks to meet Army specifications is described. The topics include mineral dyeing, vat dyeing, water-repellent finishes and mildew and mildewproofing. Many of the commercial fungicides are discussed.

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POLYMERIZED METHYLENE COMPOUNDS. L. Coes, Jr., and C. E. Barnes (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,317,130, April 20. An aromatic diamine is polymerized with an unsaturated methylene ketone or aldehyde.

FILM FORMATION. R. F. Conaway (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,317,131, April 20. An hydroxyl-containing cellulose derivative and a monomeric alkyl ether of dimethylolurea are dissolved in an organic solvent, the solution poured into a mold, the solvent evaporated and the molded article baked until the product is insolubilized.

POLYSTYRENE PLASTIC. D. A. Fletcher (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,317,137, April 20. A polystyrene plastic having a nacreous sheen is prepared by mixing with an aluminum salt of an aliphatic acid of 12–18 carbon atoms and applying an orienting force.

ETHENOID POLYMERS. D. A. Fletcher (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,317,138, April 20. Monomer is dispersed in water with a dispersing agent, polymerization is started and, at the peak of the process, an acidic lubricant from the group consisting of saturated aliphatic acids containing 12–18 carbon atoms is added.

VINYL RESINS. T. R. Lemanski (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,317,149, April 20. Polyvinyl acetate is prepared in finely divided form suspended in an aqueous vehicle, the particles being coated with sebacic acid before drying and then drying at an elevated temperature.

UREA - FORMALDEHYDE - TRIETHANOLAMINE RESIN. G. F. D'Alelio (to General Electric Co.). U. S. 2,317,181, April 20. Urea, formaldehyde and triethanolamine hydrochloride are condensed to give a molding composition curing rapidly and having more plasticity during molding than resins prepared from mono- or diethanolamine.

EDGE GLUING PROCESS. G. F. Linquist (to I. F. Laucks, Inc.). U. S. 2,317,281, April 20. Surfaces are united with a cold-setting glue by placing the entire assembly under pressure, curing a part of the glue line with heat, releasing the pressure and allowing the uncured part to cold cure under the pressure exerted by the heat cured part.

COATED CORK COMPOSITION. P. W. Kinney (to Armstrong Cork Co.). U. S. 2,317,328, April 20. Aldehyde-insolubilized binder, which liberates free aldehyde and cork, bearing on its surface a dried adhesive coating of a mixture of water-soluble polyacrylic resin with additional adhesive.

RESIN ADHESIVE. N. A. Bruyne and C. A. A. Rayner (to Aero Research, Ltd.). U. S. 2,317,364, April 27. Adhesive for bonding to a hardened formaldehyde condensation product by coating at least one surface with an aniline-formaldehyde condensation product and an initial phenol-formaldehyde condensation product, applying coated surface to the second surface and hardening the adhesive at 140° C. and 200 p.s.i.

PRINTING COMPOSITION. A. E. Gessler and D. J. Bernardi (to Interchemical Corp.). U. S. 2,317,372, April 27. High finish prints are made on surface of a traveling web with a press-stable ink containing a petroleum hydrocarbon liquid; ink film is dusted with a composition consisting of a resin having softening point of at least 100° C., removing excess resin and heating printed surface to melt the powder.

PLASTICIZER. E. Higgins (50 percent to M. C. Meyer). U. S. 2,317,380, April 27. Chlorinated rubber plasticized with an ester of tri-carballylic acid.

RELIEVING STRESSES IN PLASTICS. J. H. Seaton (to B. F. Goodrich Co.). U. S. 2,317,409, April 27. Stresses are relieved in an anisotropic thermoplastic material by moving it through a heating zone in which it is exposed to radiant energy sufficient to raise its temperature to a point at which internal stresses are relieved, the material being free from tension during passage through the heating zone.

LAMINATED TOBOGGAN. H. N. Smith. U. S. 2,317,414, April 27. Toboggan having front and rear sweeps constructed of 2 or more layers of wood in which the grains lie at right angles to each other united by a plastic.

PLASTIC SHEETS. D. Domizi (to Carbide and Carbon Chemicals Corp.). U. S. 2,317,447, April 27. Calender for forming sheets from a bank of unsheeted material and method for forming sheets of uniform thickness with a dull matte finish from a polyvinyl partial acetal resin by passing through a roll having a frosted surface.

FORMALDEHYDE - CROTONALDEHYDE CONDENSATE. W. E. Hanford and R. S. Schreiber (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,317,456, April 27. Condensation of formaldehyde and crotonaldehyde in the presence of an alkaline catalyst followed by hydrogenation of the aldehyde group in the product to an alcohol.

IMPREGNATION OF FIBROUS MATERIALS. E. Schuelke. U. S. 2,317,487, April 27. Sufficient polyhydric alcohols to esterify a mixture of polymerized fatty acids and polymerized esters to give a viscous oil which is used to impregnate fibrous material followed by a baking process which completes esterification to give a solidified product.

TEXTILE FINISH. W. W. Trowell (to Hercules Powder Co.). U. S. 2,317,499, April 27. Textile is treated with aqueous emulsion of a cellulose ethyl ether, containing the radical of a fatty acid having at least 12 carbon atoms, in a volatile organic solvent followed by heating to fuse the deposited composition to the fibers.

POLYMERIZED CARDANOL. S. Caplan (to Harvel Corp.). U. S. 2,317,585, April 27. Cardanol is polymerized by heating in contact with a dialkyl sulfate giving a product which is reactive with aldehydes, etc., is further polymerizable to a fully polymerized liquid.

CASHEW RESINS. S. Caplan (to Harvel Corp.). U. S. 2,317,586–7, April 27. Rubber-like material obtained by treating cardanol, and hydrocarbon ethers of cardanol and cashew nut shell liquid with anhydrous hydrofluoric acid and an infusible resin is obtained by heating dialkyl sulfate and furfuraldehyde with cashew nut shell liquid, marking nut shell liquid or treated japanese lac. (*Please turn to next page*)

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CONDENSATION COMPOSITION. M. T. Harvey (to Harvel Corp.). U. S. 2,317,607, April 27. A phenol of the class of hydroxybenzene, naphthol, anthranol, etc., mixed with a phenol having an unsaturated hydrocarbon substituent is condensed in the presence of a ketenoid condensing agent.

CASHEW NUT SHELL RESIN. E. C. Homan (to Harvel Corp.). U. S. 2,317,611, April 27. A solution of a cashew nut shell liquid and a solution of an organic solvent soluble urea-formaldehyde in an alcohol having from 4–14 carbon atoms are converted by heat into an infusible resin which is resistant to a group of organic solvents.

RESINOUS COMPOSITIONS. H. C. Cheetham and C. L. Levesque (to Resinous Products and Chemical Co.). U. S. 2,317,668, April 27. A polyhydric alcohol is condensed with the clear viscous residue from vacuum distillation of by-product acids obtained in preparation of sebacic acid from castor oil by treatment with alkali.

PREPARATION OF HOLLOW ARTICLES. A. W. Larchar (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,317,687, April 27. Extrusion head and apparatus for continuous formation from fluid plastic material of seamless thin-walled tubing of substantially uniform cross section.

VINYL COATING. K. Billig (to Alien Property Custodian). U. S. 2,317,725, April 27. Coating composed of aqueous solution of ammonium salt of copolymer of vinyl acetate with crotonic acid, which dries to water-proof hard film.

MOLDED HOLLOW PLASTIC OBJECT. F. C. Hall. U. S. 2,317,763, April 27. Molding powder is placed in a form, blowing tube is inserted and finally heat and fluid pressure are exerted to produce hollow molded article.

CELLULOSE ESTERS. R. Hofmann and W. Rohm (to Alien Property Custodian). U. S. 2,317,767, April 27. Cellulose is pretreated with a lower fatty acid and then reacted with an esterifying mixture of a lower fatty acid anhydride, an organic diluent which is non-solvent for the ester formed, and sulfuric acid at 30°–70° C.

RESINOUS COMPOSITION. A. Wolfram and H. Jahn (to Alien Property Custodian). U. S. 2,317,842, April 27. Aliphatic polymers of acetylene, having at least one double bond in addition to the triple bond, are reacted at 10° C. with an aromatic hydrocarbon using a Friedel-Craft's condensation catalyst.

STYRENE COPOLYMERS. F. J. Soday (to United Gas Improvement Co.). U. S. 2,317,857-8-9, April 27. Styrene is polymerized with partially polymerized isoprene, butadiene and piperylene through the aid of heat and an acid-acting metallic halide catalyst.

ISOBUTYLENE POLYMER. L. B. Turner (to Jasco Inc.). U. S. 2,317,868, April 27. Mixtures of an isoolefin and a diolefin are polymerized by adding flowers of sulfur at −40 to −100° C., and then adding a solution of aluminum chloride in ethyl chloride.

ISOBUTYLENE POLYMERS. L. A. Bannon (to Jasco Inc.). U. S. 2,317,878, April 27. Liquid isobutylene is polymerized by dissolving boron fluoride in an inert liquified gas which boils at the polymerization range.

EXTRUSION DEVICE. J. L. Ellis (to Joe Lowe Corp.). U. S. 2,317,897, April 27. An extrusion machine in combination with an inner sleeve defining a chamber for containing plastic material, the flow of which is controlled by a sleeve cutter which is coordinated with a pump.

MELAMINE-FORMALDEHYDE ADHESIVE. G. Widmer and W. Fisch (to Ciba Products Corp.). U. S. 2,318,121, May 4. Melamine-formaldehyde condensation product in aqueous dispersion containing starch and an ammonium salt capable of producing an acid.

INJECTION MOLDING. M. A. Crosby (to Hydraulic Development Corp., Inc.). U. S. 2,318,203, May 4. Apparatus for injection molding of thermoplastic and thermosetting materials, equipped with heating cylinder heated by infrared ray lamps, feeding apparatus and ejection mechanism.

DISPERSION OF ALKYL METHACRYLATE POLYMER. J. E. Smith (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,318,429, May 4. Polymerized alkyl methacrylates are dispersed in water by use of partially saponified polyvinyl acetate.

ASBESTOS YARN. K. E. Ripper (to American Cyanamid Co.). U. S. 2,318,560, May 4. Asbestos yarn is impregnated with melamine-formaldehyde syrup, dried, and the resin polymerized.

SHEET MATERIAL PRODUCTION. E. R. Derby and F. A. Parkhurst (to Monsanto Chemical Co.). U. S. 2,318,469, May 4. Apparatus consisting of an extrusion orifice for applying molten thermoplastic material to a moving belt to form sheeting.

CELLULOSE ESTERS. C. J. Malm (to Eastman Kodak Co.). U. S. 2,318,573, May 4. High viscosity acetyl cellulose is produced by treating cellulose, in a vessel containing residue of a previously acetylated batch, with a magnesium or calcium salt of a lower fatty acid followed by acetylation with an acetylating bath containing sulfuric acid.

MOLDED ARTICLES. L. T. Barnette (to Standard Products Co.). U. S. 2,318,589, May 11. Injection molding of thermosetting or thermoplastic materials around a central core, the core being surrounded by a material which will withstand heat, thus hiding undesirable surface effects.

GARMENT HANGER. J. Bolten and H. Spitz. U. S. 2,318,664, May 11. Garment hanger, composed of thermoplastic resin, with an embedded metal hood.

COATING COMPOSITION. J. W. Humphrey (to American Viscose Corp.). U. S. 2,318,780, May 11. Coating consisting of butyl methacrylate, vinyl chloride acetate copolymer and chlorinated diphenyl.

DENTAL RESIN. R. C. Feagin and C. H. Prange (to Austenal Laboratories, Inc.). U. S. 2,318,845, May 11. Resin prepared by polymerization of a mixture of monomeric ethyl alpha-methacrylate, dallyl itaconate, and styrene in the presence of polymeric ethyl alpha-methacrylate.

ARTIFICIAL GLASS. I. E. Muskat, M. A. Pollack, F. Strain and W. A. Franta (to Pittsburgh Plate Glass Co.). U. S. 2,318,959, May 11. A fusible heat-convertible polymer, which in its monomeric form contains two double bonds, is molded, and then treated so that the surface is further polymerized than the interior.

LENS MOLDING. C. V. Smith (to Univis Lens Co.). U. S. 2,319,014, May 11. An optically finished article is formed from a blank of resinous material by means of pressing with heat in an optically finished mold.

ALKYD RESINS. W. A. Waldie (to New Wrinkle, Inc.). U. S. 2,319,022, May 11. Oil-modified alkyd resins are prepared by reacting castor oil, glycerol and sodium acetate, cooling, and adding polycarboxylic acids with further heating.

PULVERIZED THERMOPLASTICS. F. R. Conklin (to Eastman Kodak Co.). U. S. 2,319,040, May 11. Molding particles are prepared from thermoplastic resins by mixing with plasticizer on two rolls, one of which is heated, removing the composite thus formed in a continuous sheet, and subsequently cutting the sheet into small particles. (*Please turn to next page*)

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HIGH SPEED FILM FORMATION. C. R. Fordyce and W. F. Hunter, Jr. (to Eastman Kodak Co.). U. S. 2,319,051–2–3–4–5, May 11. Photographic film bases are prepared by dissolving cellulose mixed organic esters in a solvent which will give the solution a clear, self-supporting gel, forming the gel on a film-forming surface, removing the film while it contains 50 percent residual solvent and removing the solvent.

PHENOLIC RESIN COMPOSITIONS. H. H. Lebach (to Haveg Corp.). U. S. 2,319,142, May 11. Phenolic resin which is convertible into an infusible product is mixed with an acid hardener, its amount determined by a color indicator.

PLASTIC PRODUCT. C. Snyder (to Liatex Corp.). U. S. 2,319,164, May 11. Terpin hydrate and polymerized isobutene are heated together so as to give a resinous material.

MOLDED ARTICLE. E. Van der Pyl (to Agicide Laboratories, Inc.). U. S. 2,319,182, May 11. Article made of raw thermoplastic nut shell material heated under pressure.

POLYCYCLOPENTADIENE RESIN. F. J. Soday (to United Gas Improvement Co.). U. S. 2,319,271, May 18. Benzene-soluble hydrogenated resinous polycyclopentadiene ranging in color from light to colorless.

ION EXCHANGE AGENTS. H. Wassenegger (to Alien Property Custodian). U. S. 2,319,359, May 18. Phenol is condensed with an aldehyde containing an acid radical.

PHENOLATED RESINS. W. H. Carmody and H. E. Kelly (to Carmody Research Laboratories, Inc.). U. S. 2,319,386, May 18. A high-melting terpenic hydrocarbon resin is made by heating preformed, high-melting pinene polymers in an inert solvent with phenol in the presence of a Friedel-Crafts catalyst.

COATING COMPOSITION. F. W. Corkery and S. G. Burroughs (to Penn. Industrial Chemical Corp.). U. S. 2,319,389, May 18. Thermoplastic coatings composed of paraffin wax and polymers of unsaturated carbocyclic terpadienes.

MOLDING APPARATUS. A. A. Burry. U. S. 2,319,439, May 18. Cylinder having discharge orifice, pressure means for ejecting plastic and heating jacket to ensure uniform plasticizing.

INJECTION MOLD. C. D. Ryder (to Grotelite Co.). U. S. 2,319,479, May 18. A pair of mold heads, one movable, and means for engagement and locking thereof.

INJECTION MOLD. W. R. Tucker (to Hydraulic Development Corp., Inc.). U. S. 2,319,482, May 18. A plastic injection cylinder with means for heating below critical temperature and mold cavity with means for heating above critical temperature of a thermosetting resin.

RESINOUS COMPOSITIONS. M. C. Agens (to General Electric Co.). U. S. 2,319,575–6, May 18. Esterification product of a polyhydric alcohol, tetrahydrofurfuryl alcohol and an alpha unsaturated alpha beta polycarboxylic acid, and a composition comprising a peroxidized ester of a polycarboxylic acid and an alcohol ether containing a single hydroxyl group and at least one ether linkage.

TREATING COMPOSITION. A. B. Clark (to Technicolor Motion Picture Corp.). U. S. 2,319,660, May 18. Composition, for vapor phase treatment of cellulose derivatives, consisting of camphor, ethyl alcohol, propanol-butanol mixture, dimethyl phthalate and water.

WELDING APPARATUS. V. E. Hofmann (to Owens-Illinois Glass Co.). U. S. 2,319,683, May 18. Apparatus for welding complementary sections of a hollow thermoplastic article by heating the two surfaces to be joined and subsequently pressing them together.

LAMINATED MICA. F. G. Pellett (to General Electric Co.). U. S. 2,319,780, May 25. An electrical insulating material composed of mica flakes bonded together with a mixture of polyvinyl acetate and an alkyd resin.

ABRASIVES. L. Coes, Jr. (to Norton Co.). U. S. 2,319,791–2–3–4, May 25. Grinding wheel, or other abrasive surface, formed by bonding abrasive grains with alkyd resins, amine-formaldehyde resins and aniline-formaldehyde resins, each being hardened by suitable hardeners.

INTERPOLYMERS. G. F. D'Alelio (to General Electric Co.). U. S. 2,319,798–9, May 25. Polymerizable unsaturated alkyd resins are interpolymerized with phthalic di-esters of halogeno-allyl alcohols and poly-(halogenoallyl) esters of polycarboxylic acids.

ADHESIVE. F. G. Pellett (to General Electric Co.). U. S. 2,319,826, May 25. Adhesive composition, the resinous component being a mixture of polyvinyl acetate and a resinous reaction product of 3,6-endo methylene-delta-4-tetrahydrophthalic anhydride and a polyhydric alcohol and the reaction product of maleic anhydride and a polyhydric alcohol.

COATING COMPOSITION. A. K. Doolittle (to Carbide and Carbon Chemicals Corp.). U. S. 2,319,852, May 25. Coating prepared from a solution of vinyl chloride acetate copolymer in a partial solvent, which is fluid and clear at elevated temperature, by emulsifying the solution in water and cooling to a gel.

SLEET BLADE. R. J. Oshei and R. C. Timm (to Trico Products Corp.). U. S. 2,319,904, May 25. Windshield wiper consisting of a wiping element composed of a corrosive anti-freeze chemical, and a molded plastic holder therefor.

ADHESIVE TAPES. E. G. Kerr (to Allied Chemical and Dye Corp.). U. S. 2,319,933, May 25. Permanently tacky, pressure-sensitive tapes are prepared by applying, to a flexible backing, a mixture of paracoumarone resin and chlorinated rubber.

LIGNOCELLULOSE RESINS. A. W. Schorger (to Burgess Cellulose Co.). U. S. 2,319,951–2, May 25. Thermoplastic resins are prepared by reacting lignocellulose with a phenol.

HEAT STABILIZER FOR VINYL RESINS. W. Scott (to Wingfoot Corp.). U. S. 2,319,953–4, May 25. Vinyl resins are stabilized against heat by incorporation of alkali metal, alkaline earth metal and lead phthalimides, and the alkali metal, alkaline earth metal and lead aryl sulfonamides.

ADHESIVE. H. J. Tierney (to Minnesota Mining and Manufacturing Co.). U. S. 2,319,959, May 25. Adhesive composed of a polyisobutylene elastomer and a hydrogenated indene, coumarone or dicyclopentadiene resin.

COATING. C. H. Groff (to Stoner-Mudge, Inc.). U. S. 2,320,126, May 25. A drying oil and an oil-soluble, unmodified, alkali-condensed, phenol-formaldehyde reaction intermediate mixed to give an incompletely resinified coating which is resinified with heat.

UREA-FORMALDEHYDE ADHESIVE. P. O. Powers (to Armstrong Cork Co.). U. S. 2,320,301, May 25. Urea and formaldehyde are dissolved in water, the pH is adjusted to and maintained at 5.5–7.0, while the mixture is heated for three hours, and then boiled at a pH of 9 until it contains 20 percent water.

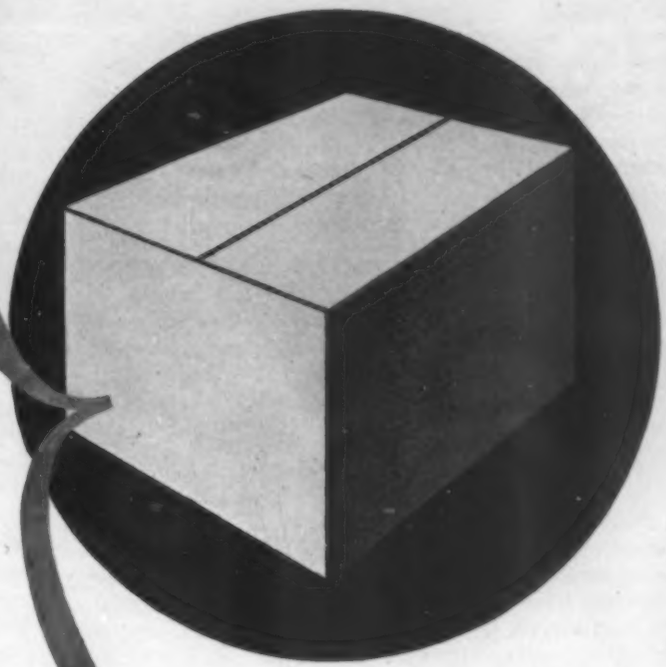
RETRACTILE ARTICLE. R. Picard and R. Fays (to Alien Property Custodian). U. S. 2,320,381, June 1. Method of forming articles, having sufficient plasticity in the gel state to permit stretching, by preparing a solution of a water insoluble cellulose acetate in the desired shape, coagulating, impregnating with a plasticizer which acts as a swelling agent, maintaining in gel state until article is positioned in place for ultimate use, and finally drying.

SECRET PLASTICS WEAPON

The box contains an item whose identity and function must remain confidential. We wish we could go into details because it is such a fascinating and impossible job of plastics manufacture.

We can tell you this: it's molded out of ethyl cellulose, has metal inserts, ball-bearings, springs and other pieces. It is *precision* to the Nth degree and is conserving 200,000 pounds of aluminum.

We would like to tell you more—to show you how Cruver engineers plastics by many methods to perform difficult operations. Perhaps we'll be able to tell you more after the war. Meanwhile, the other Cruver war jobs, which are already a matter of public record, will have to speak for us.



One of Cruver's secret war jobs—even more precise and daring than other publicized applications.

Cruver

MANUFACTURING COMPANY

NEW YORK
2 West 46th St.
Wisconsin 7-8847

CHICAGO
2456 W. JACKSON BLVD.
Seeley 1300

WASHINGTON
Hotel Washington
Met. 5-900, Ext. 650

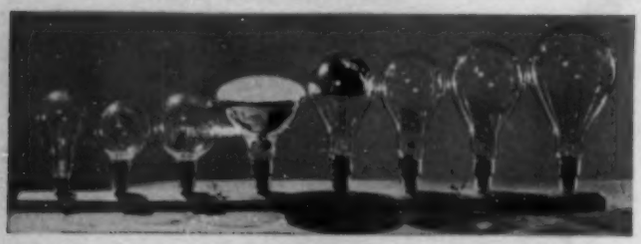
SPECIALISTS IN CONVERTING PLASTICS TO WAR

MACHINERY and EQUIPMENT

★ THE SPECIAL PRODUCTS SECTION OF GENERAL Electric Co. has a new electronic time-interval meter for accurately measuring the time interval between two events which can be converted into electrical impulses, such as the lapse of time between the closing of two controls. This unit consists of an electronic panel and a photo-tube with its preamplifier stage and has eight ranges varying from .0001 sec. to 3 seconds. A standard indicating instrument calibrated in milliseconds gives a direct reading, which it will continue to indicate after measuring until pressure on a push button clears the dial for another reading.

★ A NEW DRIVE ARRANGEMENT FOR THE INverted vertical triplex pumps of the Aldrich Pump Co., Allentown, Pa., provides for built-in pump gearing with extended pinion shaft. This means that the pump now can be supplied with any of three drive arrangements: direct to gear-head motor; through chain, flat or V-belt drive from extended crankshaft; and through built-in pump gearing.

★ DESIGNED TO MEET GOVERNMENT REQUIREments, a new photoelectric protective system that can project a fence of invisible light over a distance as great as 1500 ft. and give instant local or central-station alarm, has been introduced by Photoswitch Inc., Cambridge, Mass. The unit is particularly suited for the protection of harbors, yards, docks, industrial properties and airports. In operation, the light source is aligned with the receiver to which it focuses a modulated beam of infrared light, the only frequency light to which the receiver will respond. When the invisible beam of light is broken, the alarm circuit latches in operation.



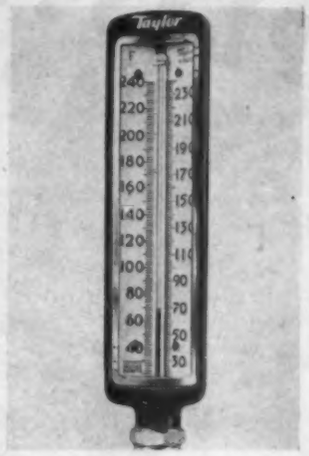
★ THE ELIMINATION OF ENCLOSURES TO PERMIT ready escape of vapors and consequent speed-up in the drying, heating, baking or dehydrating process, is one characteristic claimed by North American Electric Lamp Co., St. Louis, Mo., for its line of carbon filament lamps for infrared ray processes. These lamps, including the inside-silvered, self-reflector type and the bull's-eye silver type, are said to yield greater efficiency in the desired infrared ray bank with a minimum of visible lamp. Sturdy construction plus the ruggedness of the carbon filament are said to make for longer life and greater economy.

★ SIMPLICITY OF OPERATION OF THE VERSATILE Roan Tool and Cutter Grinder for practically all types of milling cutters is claimed by Roan Mfg. Co., Racine, Wis. The tool is designed for accurate grinding in less time than normally required. The motor head and bracket can be raised, lowered and swiveled around the upright column; the motor can also be swiveled. An independent precision slide, O.D. grinding fixture and other accessories are provided. The base unit is 18 × 16 in., height of column 25 in.; weight, 175 lb. with all fixtures.

★ ANNOUNCEMENT OF A NEW TYPE HYDRAULIC press has been made by Hydraulic Machinery, Inc., Dearborn, Mich., built in 25-, 75- and 100-ton sizes adapted to capacities up to 150 tons and operated by separate motor-driven power units. Manually controlled with a 4-way valve, it automatically cuts off when predetermined pressure has been reached. Power cylinder is assembled vertically on the top and above the base platen. Daylight, length of stroke, diameter of cylinder are built to specifications. The press occupies a floor space of 25 × 50 in.; platen, 27 in. from floor; overall height of 75-ton press is 82 inches.

★ FEEDING AND HOLDING WORK PIECES DURING drilling operations are greatly simplified by a semi-automatic fixture known as the Disc-Feeder, manufactured by Mead Specialties Co., Chicago, Ill. Operating at a handling capacity of between 3000 to 5000 per hr. by a foot control valve the feeder can handle flat stock in a variety of shapes as well as small cylindrical work if special attachments are added. An approximate range of 1 to 3 in. in diameter and $^1/_8$ to $^3/_4$ in. in thickness can be accommodated.

★ FOLLOWING EXTENDED field tests, Taylor Instrument Companies, Rochester, N. Y., have introduced a new industrial thermometer in a 1-piece shallow case which makes the mercury visible through a wider angle. The bezel fits snugly into the grooved case in a manner to hold the glass front against 4 wavy tension springs. This construction is said to result in a dustproof, rattleproof and practically fumeproof instrument. The thermometer will be equipped with Binoc tubing in many combinations of straight and angle stems and in many standard temperature ranges. The improvements are designed to give permanent accuracy and responsiveness to temperature change while saving critical material.



★ THE NEW SERVO SUB-ZERO COOLER, DESIGNED to cool specimen under test to any desired temperature from +165° F. to −100° F., is announced by Tenney Engineering, Inc., Montclair, N. J. This unit, which uses carbon dioxide as a refrigerant, is portable and arranged for attachment to small enclosures built about the specimen. These enclosing boxes can be built locally, being insulated with about 2 in. of ordinary insulation. After it is connected to the specimen box, the Servo unit is plugged into an ordinary wall socket and charged with 50 lb. of dry ice. Temperature is controlled by the automatic starting and stopping of the blower motor, while the rate of cooling is controlled manually by means of a damper.

★ TO PERMIT AN ACCURATE METHOD OF MEASURing the toughness of surface finishes and their resistance to such abuses as digs and scrapes which are not considered normal, the Taber Instrument Corp., North Tonawanda, N. Y., have introduced a new Shear-Hardness attachment for Taber Abraser. In testing samples which may be no larger than 4 in. square, a weight slides along a calibrated beam until in a position where the correct load permits the tool point to cut a groove in the surface without digging into the base plate. The most representative of several grooves is picked for measurement to the nearest thousandth of an inch by a Taber micrometer. The shear-hardness is calculated from the reading taken at the forward edge of the weight together with the width of the groove.

★ A MARKING MACHINE, PEDAL-OPERATED TO free the operator's hands for feeding, has been developed in three models by the Acromark Co., Elizabeth, N. J. It can be used for marking steel, brass, bronze, zinc, tin, fiber and plastics. The unit is small and readily placed in the production line. Adjustment from zero to $^3/_4$ in. gives ample variation for thickness of parts to be stamped.

Sky-Eyes of the Artillery

THIS IS THE L-2 GRASSHOPPER. It can take off on a dime, and dive to cover in a matter of seconds. Its function: to spot enemy positions and to direct artillery fire. Thus *visibility* is a prime pre-requisite. To get it, Taylorcraft builds the cowling of clear cellulose acetate.

BUT CRYSTAL CLARITY is not the only important reason why aviation uses acetate. Acetate has high ***impact strength*** . . . acetate is practically ***shatterproof*** . . . acetate ***resists abrasion*** of sand and dust . . . acetate ***will not craze*** in months of service . . . acetate is ***oil resistant*** . . . acetate can be ***easily repaired*** . . . acetate protects pilot and observer from often-serious sunburn.

AS YOU CONSIDER aviation's use of acetate, we hope you will think of the characteristics of acetate in terms of your own products. In no other plastic material will you find such a combination of advantages. While we do not make plastics, we have devoted years to the development of cellulose derivatives for those who do make plastics. For literature, please address Department MP-73.

Cowling made by Celanese-Celluloid Corporation of Aero-quality Lumarith.

HERCULES

CELLULOSE ACETATE

★

TOUGH • FLEXIBLE • STABLE
LIGHTWEIGHT • ECONOMICAL • CLEAR

HERCULES POWDER COMPANY Incorporated · WILMINGTON, DELAWARE

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PUBLICATIONS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

A.S.T.M. Standards on Plastics

Published by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., 1943

Price $2.00 **390 pages**

This book provides in convenient form the specifications and testing methods for plastics developed by the Society through the intensive work of its Committees D-20 on Plastics and D-9 on Electrical Insulating Materials. Ten specifications prepared during the past 12 months through the cooperative efforts of Government and industry members of the subcommittees are published here for the first time. These pertain to phenolic, urea, melamine, polystyrene, cellulose acetate and cellulose acetate butyrate molding compounds, cellulose nitrate, cast methacrylate and vinyl chloride acetate sheets, and laminated thermosetting materials. The testing methods relate to the determination of strength, hardness, thermal, electrical, optical and permanence properties. This publication should be on the desk of every engineer concerned with plastics and should be available for reference in every plastics laboratory in this country. G.M.K.

Industrial Chemistry of Colloidal and Amorphous Materials

by W. K. Lewis, L. Squires and G. Broughton

Published by The Macmillan Company, 60 Fifth Ave., New York, 1942

Price $6.00 **540 pages**

The reader with a general background in chemistry will find this book refreshing in its review of the basic principles and techniques of colloidal chemistry and stimulating in its survey of many chemical industries as interrelated through the application of these phenomena. The early chapters discuss the structure of solutions, viscosity, surface tension, adsorption, suspensions, emulsions, electrolytes, crystalline and amorphous states and gelation. The problems and processes of industries dealing with glass, ceramics, paper, leather, rubber, protective coatings, synthetic and natural fibers and organic plastics are considered in the later chapters of the book. It is well indexed and should serve as an excellent text and reference book to industrial chemists in the plastics field. G.M.K.

Adhesives

by Felix Braude

Chemical Publishing Co., 234 King St., Brooklyn, N. Y., 1943

Price $3.00 **154 pages**

Presented from a practical point of view, this book is a comprehensive study of the subject of adhesives and glues. It requires no chemical or technical training for a full understanding. The adhesives are grouped and classified according to origin and the discussion of each group deals with the merits of their applications as well as information on properties and specifications. Formulas illustrate particular types of adhesives.

★ "CANADIAN CHRYSOTILE ASBESTOS CLASSIFICATION" has been reprinted by *Asbestos*, Philadelphia, Pa., and can be obtained by sending 25 cents for a single copy, 15 cents for quantities of 10 or more.

★ THE B. F. GOODRICH CO., AKRON, OHIO, HAS REvised its catalogue section on "The Properties of Ameripol D." Such properties of this oil- and heat-resisting synthetic rubber as tensile strength, elongation, weight, color and resistance to tear, abrasion and flexing are discussed in detail while the final two pages are devoted to tables listing the properties of the various compounds of Ameripol D.

★ THE "DO'S AND DON'TS" OF CARE FOR EVERY type of persona' protective equipment are graphically illustrated in a 32-page handbook published by the Mine Safety Appliances Co., Pittsburgh, Pa. Sections of the book cover methods of sterilization and cleaning of safety devices as well as common-sense methods for repair.

★ THE FOURTH IN A SERIES OF DIGESTS OF INTERpretations of the general maximum price regulation has been released by OPM. The information, while subject to revision, shows the trend of official opinion as regards maximum prices for commodities and services, dealing in commodities or services above maximum prices, transfers of business or stock in trade, and Federal or State taxes

★ THE ELECTROCHEMICALS DEPT. OF E. I. DU PONT de Nemours & Co., Inc., Wilmington, Del., has issued a new bulletin, No. 1-1043, on "Polyvinyl Alcohol for Greaseproof and Grease-Resistant Papers." A detailed description is given of the equipment needed, coating formulas and methods of application.

★ THE LATEST CATALOGUE, NO. 100-C, OF THE SOUTH Bend Lathe Works, South Bend, Ind., makes liberal use of photographs to describe their line of engine lathes, toolroom lathes and turret lathes. Full specifications are given in tabular form and attachments for adapting the lathes to special classes of work are included.

★ EDGE MOOR IRON WORKS, EDGEMOOR, DEL., HAS a new bulletin listing its line of mixers, kettles, blenders, autoclaves and storage tanks. Brief descriptions are amplified by cross sections of the varying units with tables showing standard capacities and dimensions.

★ THE CARRIER CORP., SYRACUSE, N. Y., has a new condensed catalogue containing complete details regarding the application, specifications, features and installation of 16 types of Carrier equipment. A listing of 105 war production uses is featured in this 12-page booklet.

★ THE EXTENDED APPLICATION OF PHENOLIC resins for brush bristle settings as developed by Wooster Brush Co. is made available to all brush manufacturers through a recent folder brought out by the Bakelite Corp., New York, N. Y Among the advantages claimed for this process of setting brush bristles is that the bond is extremely strong and unaffected by hot or cold water or by strong cleaning solvents. Copies are available from the editor of *Bakelite Review*.

★ ELMER E. MILLS CORP., CHICAGO, ILL., HAS ISSUED a 6-page circular describing the new Mills-Plastic tubing and fittings which are of S.A.E. type in sizes of $\frac{1}{8}$ in. to $\frac{3}{4}$ inch. Chemically resistant and designed especially for high working pressures, these saran fittings have many applications which are listed in the leaflet together with detailed data and charts showing working pressures.

★ TO ENABLE PRODUCTION DEPARTMENTS TO select precision products fitted to meet specific needs, Hardinge Bros., Inc., Elmira, N. Y., have a compact bulletin which will be furnished upon request. Illustrations of lathes, milling machines and attachments are accompanied by concise descriptions and lists of specifications.

★ THE ALDRICH PUMP CO., ALLENTOWN, PA., IN ITS catalogue No. 100 illustrates representative pumps and hydraulic equipment and describes the many types available with a full list of their applications.

SYNFLEX FT 11

a low temperature (transparent) rubberlike synthetic tubing for electrical insulation

DIELECTRIC STRENGTH	DRY—1000 VPM WET— 910 VPM
POWER FACTOR (60 cycles)	0.10
LOW TEMPERATURE RESISTANCE	
FLEXIBILITY: (Bends around ½" mandrel while immersed in cold solution without fracture or cracking)	-63.4° F. (-53° C.)
IMPACT: (Drop Hammer Method)	-56.2° F. (-49° C.)
ELEVATED TEMPERATURE RESISTANCE	188.6° F. (87° C.)

Wires insulated with standard #8 tubing were crossed and a load of one kilogram applied for 24 hours at 87° C. — (188.6° F.) did not deform, break through, become tacky or bond.

LINEAR SHRINKAGE (After 1 hour at 105° C.)	1.5%
TENSILE STRENGTH	3200 P.S.I.
FLAME RESISTANCE	does not support combustion
WATER ABSORPTION (After 24 hours immersion at 25° C.)	0.4% by weight
HARDNESS, SHORE "A"	50-55
ELONGATION AT BREAK	295%
ELONGATION RECOVERY	
250% stretch:	
Recovery after 1 minute	93.5%
Recovery after 30 minutes	94.5%
CHEMICAL RESISTANCE	
Alkalies, weak and strong acids	unaffected
Aromatic Hydrocarbons—	
Aliphatic Hydrocarbons	slight stiffening
Ketons and Esters	affected
Hot transformer oil (105° C.—1 hour)	unaffected
COLORS: Transparent, Black.	
SIZES: Standard B & S wire gauge sizes from #24 with a .021 I.D. to a 2.000 I.D.	

*All tests made with standard #8 tubing.

SYNFLEX FT 11 tubing available in special sizes and colors upon request.

INDUSTRIAL SYNTHETICS CORPORATION

60 WOOLSEY STREET, IRVINGTON, NEW JERSEY

WASHINGTON ROUND-UP

Current news, Government orders and regulations affecting the plastics industry, with analysis of the plastics situation

UREA AND MELAMINE ALLOCATION ORDER M-331

No supplier shall use or deliver urea or melamine aldehyde resin or molding compound and no person shall accept delivery thereof from a supplier, except as specifically authorized in writing by the WPB, on and after July 1, 1943, according to terms of the new Allocation Order M-331. Each person authorized to accept delivery shall use his material and products made therefrom only for the purpose authorized. Monthly allocations will be based on the amounts of material available for distribution and the essentiality of the uses stated in the customer's PD-600 applications. In the case of marginal essentiality, the most complete and full description of end use is necessary to insure proper consideration.

Recently the user has been giving his supplier an order specifying end use of the material. Beginning with July deliveries, he places his order with the urea or melamine resin supplier and in addition files *four* copies of Form PD-600 with WPB in Washington and sends one copy of this form to his supplier with the order. This PD-600 is executed similarly to those required under the phenolic resin order. In reporting end use on PD-600, the product manufacturer (molder, plywood manufacturer, etc.) need not require end use certification from his customer if the end use is already apparent to him (buttons, for example). However, where all or a portion of the manufactured product is to be furnished to one of the armed services, he must retain in his files written evidence of that fact. The manufacturer must have proof which indicates the use of a definite amount of his product for the armed services. If his order for buttons is 60 percent for the armed services and 40 percent civilian, he must say so.

General exemptions—After an allocation has been made, a particular grade can be changed or material can be exchanged for another grade with the same raw materials without specific re-authorization from the WPB as long as the end use remains the same. Specific authorizations will *not* be required for intra-company deliveries.

Applications and reports—In making applications and reports, substantially the same procedure is to be followed as with Order M-246 (phenolics), except that there are two more classes of products, namely, textiles and adhesive uses other than for plywood (principally cardboard cartons). For August and following months, PD-600 forms should be in the hands of WPB in Washington by the 8th of the preceding month.

CELLULOSE ACETATE ORDERS

For the purposes of controlling cellulose ester flake and cellulose plastics, Allocation Order M-326 and Supplementary Allocation Order M-326-A were issued June 8, 1943, effective July 1. The Plastics Section of WPB issued the Supplementary Order (M-326-A) covering molding powder, sheets, rods and tubes in primary form produced from cellulose ester flake as a means of controlling the end use of cellulose ester flake in plastics. Exemption from WPB authorization is provided for delivery, use, or acceptance of delivery of 100 lb. or less of cellulose ester flake in the aggregate during any calendar month. Also exempted are 100 lb. or less of cellulose plastic molding powder, 50 lb. or less of cellulose plastic sheet, 50 lb. or less of cellulose plastic rods and 50 lb. or less of cellulose plastic tubes. These orders *do not* cover cellulose nitrate or ethyl cellulose.

Order M-326 provides for use of forms PD-600 and PD-601. Order M-326-A calls for reporting by producers and distributors only on PD-602. End uses or deliveries previously restricted in other WPB orders continue to remain restricted regardless of M-326 and M-326-A orders. Molders and fabricators have no direct contact with WPB under M-326-A. They will file a certificate with their raw materials supplier as instructed in M-326-A, paragraph (d). It is highly important to provide in this certificate a full and adequate description of end use to which the material is being put if the supplier's application under M-326 for flake to produce the desired quantity of plastics is to be given proper consideration.

TIGHT SITUATION IN PLASTICIZERS

The June and May allocations of plasticizers point up a situation that needs the careful attention of every processor in the plastics industry. For example, the allocation for phthalate plasticizers was announced as follows: "Diethyl phthalate and dimethyl phthalate were allowed for civilian plastics to the extent of 50 percent of requests in May and cut to 25 percent in June. *Dibutyl phthalate* was allowed *only* for cellophane, photographic film and food packaging. No civilian uses of any other phthalate plasticizer were allowed."

The future outlook for these cellulose plasticizers is grave, although strenuous efforts will be made to provide plasticizers for the most essential civilian uses. When M-154 was first issued, the most essential uses were listed in Class I. In the March 26 amendment, many Class II and III items were completely prohibited. If the tightness in materials and plasticizers continues, it is possible that *all* the items in Class II and III will be shut off from their supply of phthalate plasticizers. However, there is increased availability of cellulose nitrate which should relieve the situation a bit for such items as combs and toothbrushes, where non-critical camphor can be used as a plasticizer.

The critical situation regarding plasticizers was emphasized at the Pyroxylin and Vinyl Resin Coated and Fabric Industry Advisory Committee meeting in Washington last month. Substitutes were suggested for those which are not available. Information about substitute plasticizers may be obtained by writing to the Plasticizers and Glycols Unit, Chemicals Division of WPB. The solvents situation was discussed and it was stated that methyl ethyl ketone, ethyl acetate, isopropyl acetate and butyl acetate are all critical; acetone, however, is free at the present time.

ACETATE ESTERS OF BUTYL ALCOHOL ALLOCATED

General Preference Order M-159, which controls all grades of butyl alcohol, was amended May 26, 1943, by WPB to place the acetic esters of butyl alcohol also under allocation. The acetic esters include normal butyl acetate, secondary butyl acetate and isobutyl acetate. The amount of butyl alcohol going into the production of butyl acetate since the first of the year has been curtailed due to diversion of increased supplies of butyl alcohol to make other products. This has created a critical situation with regard to butyl acetate for direct and indirect military and naval uses, and made necessary the allocation of the acetic esters along with the different types of butyl alcohol.

TURNBULL LEAVES WPB

James R. Turnbull has resigned as Chief of the Thermoplastics Unit of the Plastics Section of WPB and returned to duty with the Monsanto Chemical Co., Springfield, Mass. Mr. Turnbull has been with the Plastics Section since April 1942, and chief of the Thermoplastics Unit since last January. Pending appointment of a new unit chief, the work will be continued by the present administrators of the various thermoplastic orders.

(*Please turn to next page*)

Blue-Print for Tomorrow

Columbia's post-war plans are now being readied for a great super-plant with hitherto undreamed-of plastic molding facilities. Once V-Day comes, Columbia will have a capacity far greater than ever to meet your peacetime custom-molding requirements.

COLUMBIA
PROTEKTOSITE CO., INC.
CARLSTADT, N. J.

cp
Custom plastics

BUT TODAY Columbia's vast facilities for injection molding are being devoted to the war effort. Prime or secondary contractors on war or other essential products will find us whole-heartedly cooperative. If you have an essential plastic problem, call or write Columbia.

PLASTICS OPA OFFICIAL PROMOTED

Morris L. Ullman, who has been serving as the plastics specialist in the Machinery Branch of OPA, has moved to the Los Angeles District Office where he will be head of the Industrial Materials and Equipment Section. Mr. Ullman served for 6 years as general manager of Hurst, Inc., Boston, a molder and fabricator. He has been connected with the plastics industry since 1933.

NEW RESINS AND PLASTICS PRICE REGULATION

The new regulation to establish prices for resins and plastics sold at the manufacturers' level, MPR-406, became effective June 22, 1943. Prices of resins and plastics now in existence and governed by GMPR are transferred to control under the new regulation as is. The new regulation provides formula pricing methods for automatic pricing of any *new* plastics material offered for sale and supersedes Amendment 54 to GMPR which was effective May 28, insofar as that regulation applied to new plastic materials. Prices will be held to the general level of all prices that existed for similar materials in March 1942. There will be no necessity to apply for prices for experimental products which are defined in the regulations.

All plastics manufacturers and processors should give careful study to the listed categories of commodities. They include the listed commodities in "all forms of condensation and polymerization in the forms of solids, semi-solids, granules, powders, emulsions or liquids. They are generally complex amorphous organic compounds to which fillers, plasticizers, extenders, lubricants, pigments, modifying chemicals or liquids are frequently added. Such materials may be in extruded shapes, flat sheets (including continuous sheets), rods, tubes, blocks, and preforms, before fabricating or printing."

Likewise the exemptions should be carefully examined. For example, the regulation is specifically written to cover extruded plastics, but if the extrusions are further fabricated they are exempt from this particular regulation and enter some other category. Thus, if a tube is formed, threaded, punched or made into an identifiable article, it does not come under the provisions of this regulation.

Definition of new products—The heart of the order is in the definition of new products. A different method of pricing has been established for each of 4 categories which are "the same," "nearly the same," "related" and "nearly related." In the report form to OPA showing the computation of a manufacturer's price for his *new* plastics material, plastics and resins used as a basis of comparison should, in all cases, be made by a company that has both the nearest direct costs and the most similar use for its product. If a manufacturer feels that his product does not fit any of the 4 categories he should describe his product in the best way he can with as complete information as possible and submit it on the prescribed form for OPA approval.

The regulation provides that when a price is computed by the manufacturer and a report is sent to OPA, the manufacturer may sell his product at once, but it is subject to retroactive change within 20 days. If OPA does *not* change the price within 20 days, the computed price becomes their firm price for 120 days. It should be noted that this order does *not* cover thermoplastic scrap, which is priced under MPR-345. OPA officials also point out that there never was and never will be any intent to ask for secret formulae. The manufacturer may list his catalyst or other such items as "A" or "B" and simply give the group cost provided that sufficient information is given to permit accurate pricing.

PRICE ORDERS AFFECTING NEW CHEMICALS

We have been informed that some confusion exists in the trade over what at first glance seems an overlapping of pricing regulations concerning new and experimental chemical and plastic compounds. Three OPA orders are involved. They are Amendment 54 to GMPR (new products), which became effective May 29, 1943; Revised Supplementary Regulation 1, Amendment 9 (experimental chemicals, drugs and paints), effective June 5; and MPR-406, the new price regulation for plastics and resins compounds, effective June 22.

First: Amendment 54 to GMPR authorizes manufacturers to set their own prices under GMPR for new products not sold by them or by competitors during March 1942 instead of asking the national OPA office to set the price as has been required in the past. This amendment supersedes procedure under Section 3b of GMPR. It provides a method for the manufacturer to set his own price for *new* products, unless it is specifically disapproved by OPA within 20 days after mailing the application. The price would, of course, be subject to possible later adjustment. Amendment 54 to GMPR thus covers all *new* chemicals except those which are defined in MPR-406 (resins and plastics), or those which are already defined in some other regulation such as that covering alcohol or acetic acid.

Second: Amendment 9 to Revised Supplementary Regulation 1 eliminates *experimental* chemicals, drugs and paints from price control. Plastic materials are classified as chemicals by Government agencies. By the terms of this amendment, a manufacturer may deliver an experimental chemical on condition that before making sale of such chemical which would bring total sales thereof to a sum in excess of $1000, he must file a report with OPA setting forth the name of the manufacturer, a description of the chemical, the reasons why it is experimental, the price he proposes to charge during the experimental stage and the monthly volume which he believes would represent commercial production. After it reaches commercial production, the experimental product is then to be priced under Amendment 54 to GMPR as discussed above.

Third: OPA officials point out that MPR-406 supersedes Amendment 9 to Rv. SR 1 insofar as chemicals for resins and plastics are concerned. It sets pricing arrangements for new and experimental resins and plastics sold at the manufacturers' level. It transfers control at present prices under GMPR to control under the new order at the same prices. It sets up plastics and resins raw materials as a separate entity in the OPA price structure so that future manipulations of GMPR will have no effect on plastics as such.

NAVY'S PLASTICS SECTION—AN AID TO INDUSTRY

Most people who come to Washington or even those who do business by mail generally have difficulty in gaining direct access to the right person or even to the right office. Reference to this Washington merry-go-round is always good for a laugh at any convention or bar gathering, yet it is inconceivable that perfect coordination could ever be achieved in anything as big as this war-time government. Perhaps the visitors would be surprised to learn that government people themselves frequently have a similarly troublesome time in trying to find the right agency, the right person or the proper procedure for coordinating their efforts, although all may be working on almost identically the same problems. As a means of simplifying this hunt-and-peck system the Plastic Section has been set up in the Office of Procurement and Material to function as follows:

1. To assist the Bureaus in the design and development of sound plastic applications.

2. Effect conservation, in its broadest meaning, by the use of plastics, *not as substitute materials* but as superior materials. The superiority is obviously desired in performance. However, superiority may result where performance is only equal but is augmented by definite savings in man-hours, machine hours or transportation or where definite advantages are shown such as weight savings in aircraft. In general the foregoing have assumed greater importance than mere replacement of a so-called more critical material.

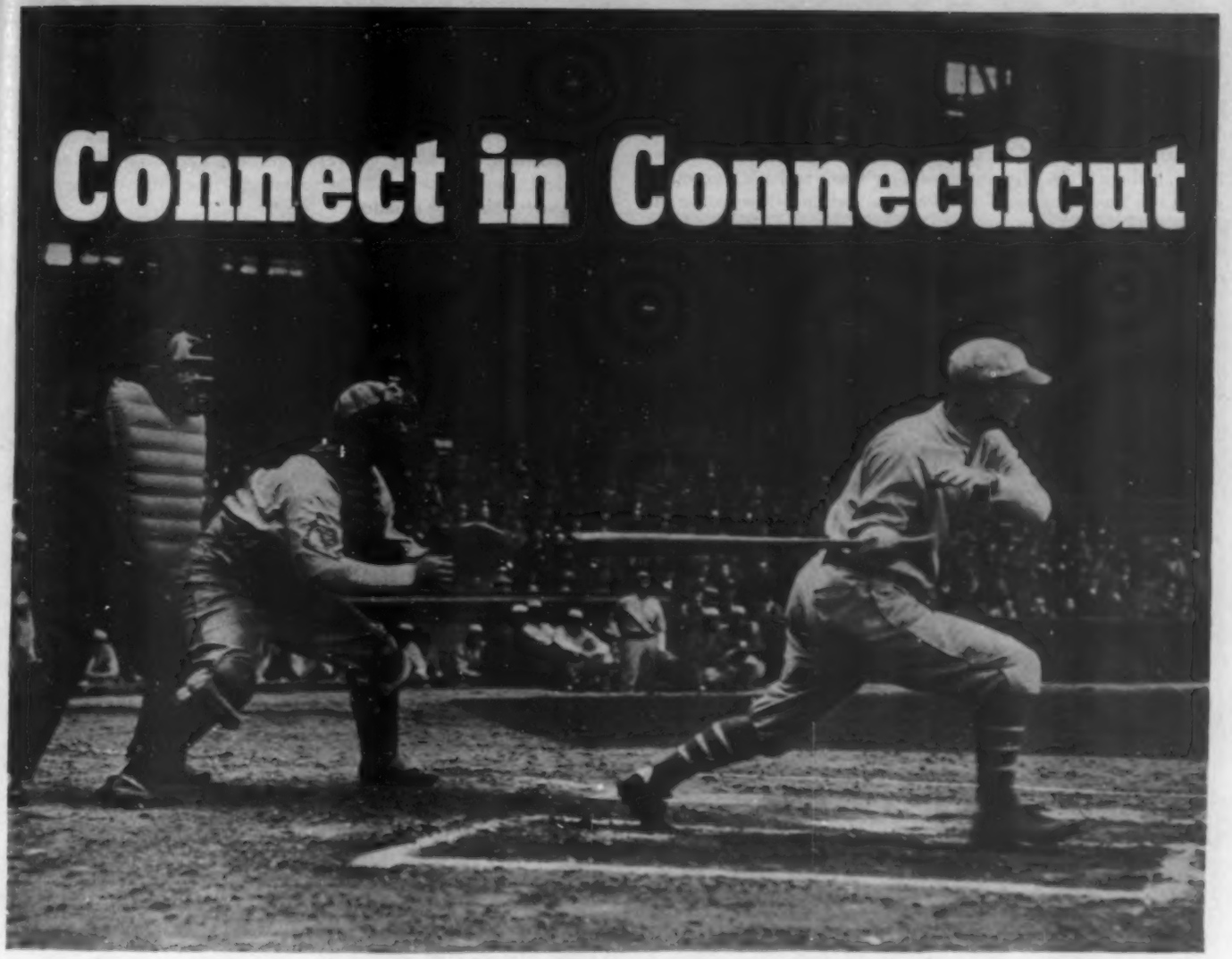
3. To coordinate and correlate the plastics activities of the Bureaus.

4. Serve as a central agency to which Navy contractors may refer their plastic problems.

5. Encourage Navy contractors, design agents and other

(*Please turn to next page*)

Connect in Connecticut



HOME-BASE YOUR PLATING PROBLEMS AT HARTFORD CHROME

Check with Hartford Chrome if you want an up-to-date picture of the progress made in hard chrome plating. Yesterday's tough problems are ordinary production jobs here. We've developed the successful application of hard chrome plating to include an endless list of molds, dies, gauges and other tools and parts. Result is that leading Eastern manufacturers home-base their plating problems here. You can connect in Connecticut too, by calling on Hartford Chrome to expedite your work.

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Navy activities to accept the use of plastics developed by the Bureaus, by industry, and by this Section.

This same Navy Department Plastics Section can serve the industry in a similar manner. Instead of running all over Washington or sending mail to various offices, time can be saved by making your initial contact with the Plastics Section of the Navy, if there is the slightest possibility that you have a product which the Navy can use. The Plastics Section will welcome all suggestions and particularly industrial plastic applications already in use which might find ready acceptance in ship or shore naval equipment.

A good example is the plastic toilet flush valve, originally designed as a conversion from metals. Members of the Plastics Section heard of it, made inquiry and found that Navy officers were more than anxious to give it a try. At the present writing new specifications are being drawn up and it is more than likely that procurement will issue for plastic flush valves. Another example is a container for heeling magnets. A Navy contractor discovered that this case was made of brass machined out of solid bar stock. A plastic sample was made up, submitted to the Plastics Section and within 2 weeks approval was granted and a contract signed for the purchase of plastic heeling magnet containers. The conversion resulted in large saving of man and machine hours as well as brass.

These are 2 methods of approach whereby the Plastics Section can be of service to the Navy and industry. Needless to state, stock plastic parts such as knobs, handles, extruded parts, etc., should not be sent to the Plastics Section, except by their request, unless the supplier has a specific sound Naval application in mind, in which case the Plastics Section will be glad to investigate.

An important factor in all governmental dealings is the follow-up. You may receive an enthusiastic reception and apparent acceptance of your ideas in some department, and go home satisfied that you have made a sale. But the pigeon holes in Washington are vast and copious. This is no criticism of public officials, but simple statement of an unavoidable fact. If your idea is pigeon-holed, your time is wasted, or at least, action is indefinitely postponed. The Plastics Section makes it their business to follow through and make certain that their suggestions get action either negative or positive. The members of the Plastics Section, having a broad knowledge of plastic materials and wide experience in the plastics industry, are well equipped to serve the Navy as well as the industry in the furtherance of a sound plastics program by coordinating developments, following up on applications and channelling information. The address is:

Plastics Section
Office of Procurement and Material
Executive Office of the Secretary
Room 2227, Navy Building
Washington, D. C.

PLASTIC CLOSURES

It is expected that, starting with August deliveries, allocations for either phenolic or urea closures will be subject to the strict limitations. The continuance of plastic closure manufacturing depends upon a successful conservation effort. Allocations will be made only for short skirt type enclosures with a minimum amount of decoration. Deep caps will be allowed where there is a necessary function to perform such as prescription ware "pour-out-lip" bottles. Specifically, a shallow skirt cap with a high dome would exceed the limit of a minimum functional weight cap. Deep skirted caps where shallow skirts would serve are outside the intended use. In short, any closure which requires more material than is necessary to make it function as a seal, in the strictest sense, may be considered as a non-qualified use of molding compound.

The problem of getting more caps out of a pound of material should be discussed with customers. Any cap user would be glad to join in a conservation program based on such points as:

1. The elimination of all decorative features which cause unnecessary weight.
2. The use of GCA 400 finish wherever possible.
3. The use of as small a neck opening on the container as permitted by the product and existing filling and handling equipment.

If the industries concerned voluntarily use their allocations in accordance with the above suggestions and make the most efficient use of the available materials, more drastic control measures should be avoided.

PLASTICS IN SHOES UNDER SCRUTINY

Synthetic and plastic soled shoes, many of them with fabric uppers and not subject to the shoe rationing program when made without critical materials, have been supplied with ceiling prices at the manufacturing level. The shoes, chiefly women's models, are made with such sole materials as plastic, felt, wood, combinations of cotton and wool, cord and friction belting and some other fabric and synthetic substances.

In line with governmental policy to combat inflationary measures due to production of inferior products, the Chemicals Division of WPB together with the Shoe and Leather Division is undertaking a program to develop quality standards for plastic shoe soles. It is essential for the industry that the right material be used in the right place. It has been proved that when properly processed, some plastics make good soles, but there have also been some poor applications. Industry leaders are confident that if properly processed, plastic soles can give top grade service and help to relieve the leather shortage, but they feel that such soles should be placed only on rationed shoes and should not be wasted on the so-called "play shoes."

PLASTICS CONSERVATION

The best conservation of critical materials is the best engineering on all materials. Washington officials are constantly trying to hammer home this idea: "The use of plastics in applications which have no other value than conservation of metal should be discouraged." Plastics uses, says a Washington plastics official, should satisfy two conditions:

A. The end use, or assembly in which they are incorporated, should be essential.

B. The plastic in question should be essential to that end use.

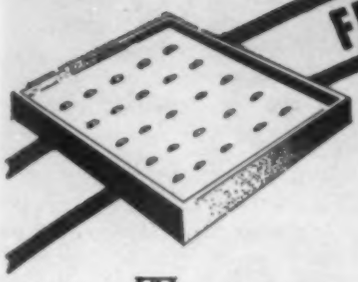
If the comparatively small tonnage of plastic materials is not used with the above qualifications in mind, some industries may be crippled for lack of essential equipment that requires plastic parts. To illustrate the point, the acetylene gas industry offers an example. Acetylene torches for cutting metals are vital to modern manufacturing methods. The torches must have handles. Heretofore, the handles have been made of brass tubing, because in normal times, when all materials competed for all uses, brass tubing won the nod for handles on the basis of sound engineering economics. If a mandatory order arbitrarily prohibits the use of brass handles, thus forcing use of laminated phenolics for their construction, the engineering principle involved is basically unsound.

Why? Because if laminated phenolics are used for handles, it is likely that there will not be enough laminated phenolics to go into some other phase of the acetylene gas industry where they are vital. For example, electric insulators in motor controls used in the manufacture of acetylene gas are vital to the industry. If the laminated phenolics allocated to the industry are used up for handles, there may not be enough for insulators, and the industry will suffer from production headaches. This example could be applied in varying degree to almost every mechanical industry. The criticalness of plastic materials and the future of the industry demands that all those interested in plastics bend every effort toward the utilization of their products in only those applications where it is best fitted to perform the task.

PLASTICS FOR PRINTING PURPOSES

The successful use of plastic material and plastic impregnated paper as a substitute for metal printing and lithographic plates in graphic art reproduction was (*Please turn to page 140*)

FROM PILLS TO AIRPLANE PARTS

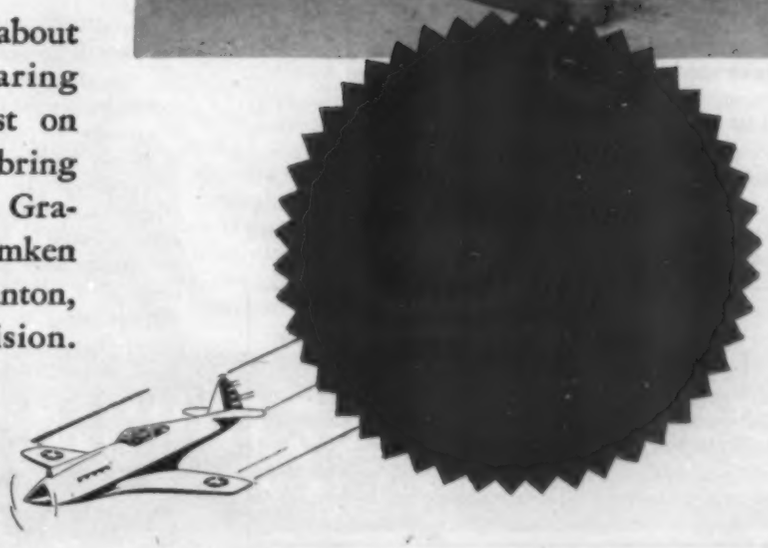


THIS huge Kux automatic powdered metal and ceramic press weighs 13,500 pounds, stands 11 feet high, and is doing a "bang out" job of producing everything from medical and vitamin pills to airplane parts for our Armed Forces.

Timken Graphitic Steel is helping Kux presses do an exceptional wartime job. Their cam inserts, cam rollers, roller pins, dies, punches, and core rods are made of Timken Graphitic Steel. The Kux Machine Company reports that Graphitic dies provide exceptional life, have excellent hardening properties and easy machinability.

"In nearly two years of service, none of the Graphitic press parts have required replacement," say Kux engineers.

Would you like to know more about this free-machining, long-wearing tool and die steel? A request on your company letterhead will bring you the latest edition of the Graphitic Steel Booklet. The Timken Roller Bearing Company, Canton, Ohio. Steel and Tube Division.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

GRAPHITIC STEELS

IN THE NEWS

★ THE FIRST ARMY-NAVY "E" TO BE AWARDED under the sponsorship of the Treasury Dept. was presented on June 3 to the employees of E. I. du Pont de Nemours & Co.'s Perth Amboy electrochemicals plant. Primarily the award was in recognition of the plant's production of hexamethylenetetramine, better known as hexamine, the chemical that is one of the basic ingredients of the new high explosive used in "blockbusters."

★ THE ARMY-NAVY PRODUCTION AWARD WAS presented on June 11, to Worcester Moulded Plastics Co., Worcester, Mass.

★ REICHHOLD CHEMICALS, INC., HAVE BEEN NOTIfied that their plants in Detroit, Mich., and Elizabeth, N. J., have been granted a second renewal of the Army-Navy "E" award. The initial award was made on May 20, 1942, and the first white star, emblematic of "continued splendid achievement in outstanding production," was granted Dec. 18, 1942. Now the pennants bear a second star.

DR. J. J. PYLE

J. W. UNDERWOOD

★ DR. J. J. PYLE HAS BEEN APPOINTED CHEMIST in charge of the plastics laboratory of General Electric Co., Pittsfield, Mass., according to an announcement by W. H. Milton, Jr., manager of the plastic div. of the company's appliance and merchandise department. Dr. Pyle, former group leader in charge of research and chemical development, succeeds Dr. G. F. D'Alelio, resigned. Mr. J. W. Underwood was named administrative assistant to Dr. Pyle.

★ THE 21ST ANNUAL MEETING OF THE AMERICAN Institute of Chemists was held in Chicago on May 15. Speakers at the afternoon session included Dr. Bruce K. Brown, Assistant Deputy Petroleum Coordinator; Dr. Robert J. Moore, manager, development laboratories, Bakelite Corp.; Dr. H. E. Robinson, research laboratories, Swift & Co.; and Dr. David Klein, president of Wilson & Co. Laboratories. The Institute's medal for outstanding service to chemistry was presented at the annual banquet to Dr. Walter Savage Landis, vice-president of American Cyanamid Co.

Because of the scarcity of stock molds brought about by wartime restrictions, MODERN PLASTICS has been forced to discontinue its Stock Molds page. However, information is now being gathered on standard extruded shapes, profiles and tubing, and we expect in the near future to present each month a page illustrating and describing these items and giving their specifications.

★ THE U. S NAVY HAS ANNOUNCED A SIMPLE AND effective method of making sea water safe to drink through the use of 3 plastic bags and 2 chemical compounds. In this treatment, a quart of sea water is put into one of the plastic bags and a chemical added which precipitates several of the chemicals in sea water. The water, now saltless but alkaline, is poured into a second bag which contains a filter. The chemical in this second bag is diffused through the solution by kneading; the water then is poured into a third bag also containing a filter. The result is clear drinking water in 30 minutes.

★ KEARNEY & TRECKER CORP., WEST ALLIS, WIS., at a recent stockholders meeting elected 5 executives to new offices. J. L. Trecker was appointed executive vice-president; R. W. Burk, vice-president in charge of sales; E. W. Trecker, vice-president in charge of manufacturing; J. B. Armitage, vice-president in charge of engineering; and R. L. Bischoff, treasurer and assistant secretary.

★ PLASTICS PROGRESS CLUB OF NEW YORK HELD its first dinner-lecture on June 4, with George K. Scribner, president of Boonton Molding Co. and newly elected president of S.P.I., as guest speaker. Mr. Scribner traced the history of the development of thermoplastic materials and gave intimate details of his company's experiences during the development of the present-day injection machine.

★ THE AMERICAN SOCIETY FOR TESTING MAterials has appointed Hugh D. Haley, engineering dept., American Viscose Corp., Wilmington, Del., to represent his corporation on committees dealing with plastics for electrical insulating.

★ DOW CHEMICAL CO., MIDLAND, MICH., HAS ANnounced the formation of a new Division designed to develop chemical products for use now and in the postwar era, and to extend the wartime usages of present products and facilities. This division will be headed by D. K. Ballman, whose duties for the past 8 years have included product development and technical service work.

★ CHICAGO MOLDED PRODUCTS CORP., CHICAGO, Ill., announce the election of the following officers: Maurice C. Bachner, chairman of the board; Edward F. Bachner, president and general manager; Marcel F. Bachner, vice-president and treasurer; John J. Bachner, vice-president in charge of sales; Louis H. Bachner, secretary and asst. treasurer; Bruce Balderson, controller; and James T. McKenna, asst. secretary.

★ QUADRUPLING THE PRODUCTION OF PLEXIGLASS sheet for bomber noses, gun turrets, astro domes and other transparent plane enclosures, Rohm & Haas Co., Philadelphia, Pa., have opened a new plastics plant in Knoxville, Tenn.

★ A GUEST SPEAKER AT THE MAY 28 MEETING OF the Detroit Section of S.P.E. was John Haines, Yardley Plastics Co., who discussed "Dry Extrusion." Crediting the needs of automobile companies for the rapid development of dry thermoplastic extrusions technique, he detailed the customary method of extrusion molding and mentioned important factors affecting this method. In conclusion he said that by a modified system of extrusion molding whereby sections are made by forming the material after it leaves the extruder, it now is possible to make sections as large as 6 in. wide by $^{3}/_{8}$ in. thick, to make rods as large as 2 in. in diameter or larger, and to make round pipe corresponding to 4 in. black iron pipe size. Mr. Haines also noted that such small objects as bottle caps and badges have been made by forming the hot material just as it leaves the die, a method he described as extremely rapid and accurate.

Other speakers at this final spring meeting were William Cruse, executive vice-president of S.P.I., who briefly discussed WPB forms; Phil Robb, secretary-treasurer of S.P.E.; and John S. Bugas, chief of the Detroit office of the F. B. I., who described wartime plant protection problems. (*Please turn to next page*)

From Technical Bulletin prepared by the Nicholson Research Department:

The synthetic plastics in general have an abrasive action on all cutting tools, and files are no exception. Consequently, files for plastics should require special treatment or selection. They should be keen and high topped to retain their cutting edges as long as possible.

In order to minimize the tendency of plastics to clog up teeth, files for plastics should have gullets which are well rounded and wider than usual. Further to reduce clogging, they are usually furnished with a dry finish.

As a rule, flash is removed with a swift, light, sweeping filing stroke. The light pressure is an added factor in reducing the tendency to clog. Very often a drawfiling stroke is feasible and increases filing speed.

Shapes and sizes of files for plastics depend on the nature of the job. Flat, Mill, Half Round, Round and Square meet most requirements, although other Nicholson and Black Diamond shapes are also available — also several types of Nicholson X.F. Swiss Pattern. Guarantee: *Twelve perfect files in every dozen.*

Nicholson File Co., 44 Acorn St., Providence 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

FREE BOOK *"File Filosophy"*

Contains valuable information about files; metal, plastics, wood and saw filing; care of files and how to get the most service out of them. 48 interesting pages, with many illustrations. *Send for a copy.*

NICHOLSON FILES
FOR EVERY PURPOSE

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MADE IN U.S.A.

★ "LOOKING AT THE FUTURE THROUGH THE EYES of Research" was the subject of a talk given by Charles F. Kettering at the S.A.E. War Matériel meeting in Detroit on June 10. Mr. Kettering gave the Army and Navy prewar research programs all credit for the country's readiness to expand into war production immediately after war was declared. Stressing the need for yet more postwar planning groups, one to every man, he described research as being a matter of "cut and try." Mr. Kettering said that research is based upon looking ahead and being dissatisfied with what is being done. The rest is sample making.

★ BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, Pa., have appointed V. H. Peterson as assistant to the president. During the past 2 years, Mr. Peterson was vice-president of Elliott Co. with responsibility for all sales, advertising and service activities of that company's 3 plants.

★ JOHN A. FAUST HAS BEEN APPOINTED TO THE research and development laboratories staff of Bakelite Corp. in Bloomfield, N. J.

DR. R. P. DINSMORE

★ GOODYEAR TIRE & RUBBER CO., INC., AKRON Ohio, has announced the election of Dr. R. P. Dinsmore as vice-president in charge of research and development. Development manager of the company since 1939, Dr. Dinsmore pioneered in rubber research and worked on synthetic rubber development long before Pearl Harbor.

★ THE AMERICAN SOCIETY OF MECHANICAL ENgineers held its semi-annual meeting in Los Angeles, Calif., on June 14 to 17. Speaking before the Railroad Div., Morris P. Taylor, assistant mechanical engineer of Southern Pacific Co., suggested that the availability of new materials and machinery after the war will cause a radical change in railway equipment —increase railway electrication and use of Diesel engines, and improve freight cars through use of molded plywood, glued wood, and all-welded alloy steels or light metals. Addressing the full society, W. I. Beach, chief plastics engineer of North American Aviation, Inc., described a plastic forming process developed by his company, a method of treating thermosetting laminated material which permits forming of objects having simple and compound curvatures. John Delmonte, technical director of Plastics Industries Technical Institute, discussed "Wood-cloth and Wood-paper Laminates."

★ THE FIRST SYNTHETIC RUBBER MANUFACTURing plant in the British Empire, designed to produce "Thiokol," started full-scale operations in Ontario, Canada, on June 14. Operated by Naugatuck Chemicals, Ltd., affiliate of Dominion Rubber Co., Inc., this plant marks the first step away from Canada's complete dependence upon rubber imports from the United States.

★ EDMOND DU PONT, SON OF THE LATE FRANCIS I. du Pont, has been named vice-president in charge of plant operations of Wilmington Chemical Corp., New York, N. Y., with headquarters at Wilmington, Delaware. Other officers of the firm are Herbert Waller, president; Hubert I. du Pont and Edward V. Osberg, vice-presidents; and M. A. Solmssen, treasurer. The company's enlarged laboratory is under the direction of Dr. F. S. Rostler.

★ THE PLASTIC SALES ENGINEERS ASSOCIATION wound up the current series of monthly dinner meetings with a June session at the Yale Club, New York, N. Y., on June 14. Featured speakers were H. B. Birtwistle, American Encaustic Tiling Co., Inc.; G. A. Wilcox, Plastics & Resins Section, Chemicals Branch, WPB; and C. H. Whitlock, Research and Development Engineer, Monsanto Chemical Co.

Mr. Birtwistle described Formrite, a new casting compound composed of organic and inorganic thermosetting materials which have been used in the making of aircraft tools. He discussed some of the properties of the material, which is available in 3 different formulas, Formrite M, R and E. All 3 formulas are said to have the ability to flow cold and become solidified without the need of special baking heat or pressure. They are reported to be non-shrinking, resistant to water, oils and heat up to 500° F.

Second speaker on the program was Gaylord Wilcox, pinch-hitting for Walter Wagner of WPB, who discussed the allocation of phenolic resins under Order M-246, effective last December. He stressed the fact that in considering claims against monthly phenol pools, the most essential end uses are considered first and that WPB has looked for means of conserving phenol by means of extenders, has encouraged the development of new military uses of plastics only where they were doing a better job and not serving solely as substitutes. Due to this conservation policy, the watchful control of new molds (under Order L-159) and increased expansions of phenolic capacity, WPB has been able for the past month to give 100 percent allocation on all military items and most essential civilian items.

Carl Whitlock, final speaker of the evening, discussed the development program initiated on the West Coast in connection with uses of plastics for all types of aircraft fittings. While this program is still experimental, it points to a vast production demand for plastics because of over 400 fittings to be made, 20 percent could be plastics—including over 38 different styles and 10 or 15 different sizes. Principal problem to be solved is to provide a unit adequate in torque and flexural strength, since the parts have to be assembled in the field as well as in the factory.

★ ELECTION OF JOHN WOLCOTT HADDOCK AS president has been announced by Farrel-Birmingham Co., Inc., Ansonia, Conn., and Buffalo, N. Y. Mr. Haddock formerly was vice-president in charge of engineering and sales for Sullivan Machinery Co.

★ ACCORDING TO INFORMATION PUBLISHED IN A recent issue of Foreign Commerce Weekly, cast phenolic resin buckets are being produced by United Ebonite & Lorival, Ltd., Little Lever, Great Britain, for carrying acids in the electroplating and other industries. Designed to replace rubber or ebonite buckets, these plastic containers are in many cases unaffected by corrosive liquids at temperatures up to 100° C. While not recommended for caustic solutions, these buckets can be employed for carbon tetrachloride and organic solvents.

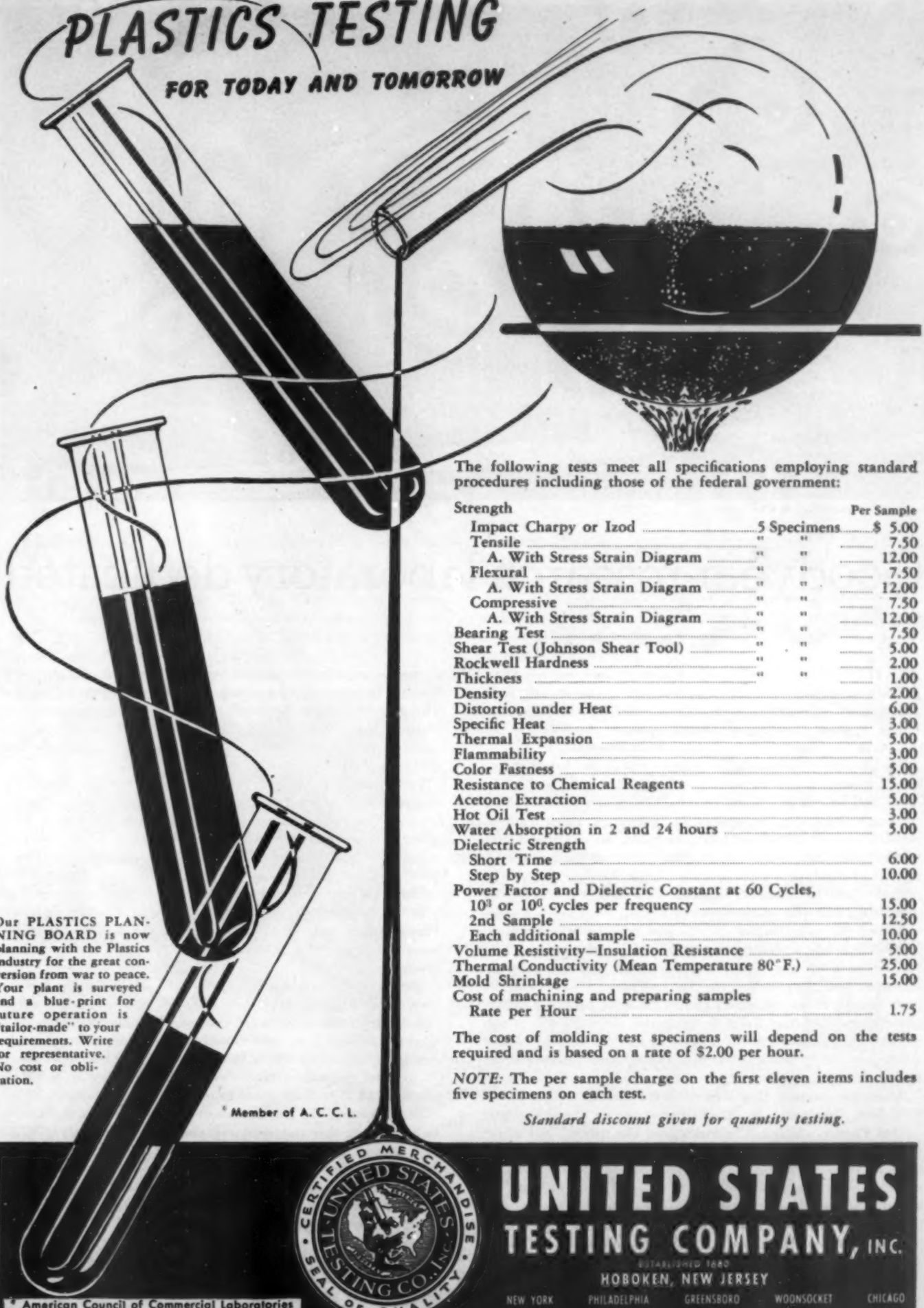
★ GUEST SPEAKERS AT THE JUNE 4 MEETING OF S.P.E. in Chicago were R. J. Metzler, technical representative, Cellulose Products Div., Hercules Powder Co., who spoke on "Ethylcellulose Plastics" and C. N. Sprankle, development engineer, Sears Roebuck & Co., who discussed "Plastics Problems in Postwar Planning."

Sorry!

★ THROUGH AN OVERSIGHT, CREDIT WAS NOT GIVEN to *Textile Research* for permission to publish the article, "Plastic-bonded cotton fiber," which appeared on page 100 of the May issue, and for the photographs which accompanied it.

PLASTICS TESTING

FOR TODAY AND TOMORROW



The following tests meet all specifications employing standard procedures including those of the federal government:

			Per Sample
Strength			
Impact Charpy or Izod	5 Specimens		$ 5.00
Tensile	"	"	7.50
A. With Stress Strain Diagram	"	"	12.00
Flexural	"	"	7.50
A. With Stress Strain Diagram	"	"	12.00
Compressive	"	"	7.50
A. With Stress Strain Diagram	"	"	12.00
Bearing Test	"	"	7.50
Shear Test (Johnson Shear Tool)	"	"	5.00
Rockwell Hardness	"	"	2.00
Thickness	"	"	1.00
Density			2.00
Distortion under Heat			6.00
Specific Heat			3.00
Thermal Expansion			5.00
Flammability			3.00
Color Fastness			5.00
Resistance to Chemical Reagents			15.00
Acetone Extraction			5.00
Hot Oil Test			3.00
Water Absorption in 2 and 24 hours			5.00
Dielectric Strength			
Short Time			6.00
Step by Step			10.00
Power Factor and Dielectric Constant at 60 Cycles,			
10^3 or 10^6 cycles per frequency			15.00
2nd Sample			12.50
Each additional sample			10.00
Volume Resistivity—Insulation Resistance			5.00
Thermal Conductivity (Mean Temperature 80° F.)			25.00
Mold Shrinkage			15.00
Cost of machining and preparing samples			
Rate per Hour			1.75

The cost of molding test specimens will depend on the tests required and is based on a rate of $2.00 per hour.

NOTE: The per sample charge on the first eleven items includes five specimens on each test.

Standard discount given for quantity testing.

Our PLASTICS PLANNING BOARD is now planning with the Plastics industry for the great conversion from war to peace. Your plant is surveyed and a blue-print for future operation is "tailor-made" to your requirements. Write for representative. No cost or obligation.

* Member of A. C. C. L.

* American Council of Commercial Laboratories

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PHOTO, COURTESY GOODYEAR TIRE & RUBBER CO.

Goodyear research laboratory dedicated

A $1,325,000 research laboratory is rarely built and equipped by a company with only one customer. Last month, such a laboratory was dedicated at Akron, Ohio, by the Goodyear Tire & Rubber Co.—whose solitary customer, however, is the biggest in the world: the United States of America.

The new three-story building, with 74,000 sq. ft. of floor space, houses a series of laboratories, a library, machine shops, workshops and executive offices; and is furnished with the latest equipment available for studies in rubber, synthetic rubber, plastics, aircraft and allied fields, including an electron microscope, analytical spectrograph and infrared spectrometer. Present research personnel consists of 125 chemists, physicists, engineers and metallurgists together with some 400 others who spend their full time in field work.

Among the objectives of the research program which will be instituted at the laboratory are listed the development of new types of resins to serve as protective coatings, molding materials or rubber replacements and the study of plastics which may be used under certain circumstances in place of rubber. Consequently the two-day scientific program (June 22–23) which marked the dedication of the laboratory and the demonstrations which preceded it provided material of particular interest to the plastics industry.

A number of new developments were announced by P. W. Litchfield, Goodyear's board chairman, among them a plastic named Plioflex which can be vulcanized like rubber, and therefore can be used in many cases where rubber is specified. This type of resin—a copolymer of vinyl chloride and vinylidene chloride—has been shown by tests to remain flexible at −40° F., a temperature at which most elasto-plastics will crack. Exposure to air and to the ultraviolet rays of the sun causes it to lose none of its properties, and its tensile strength can be improved from 100 to 200 percent during vulcanization.

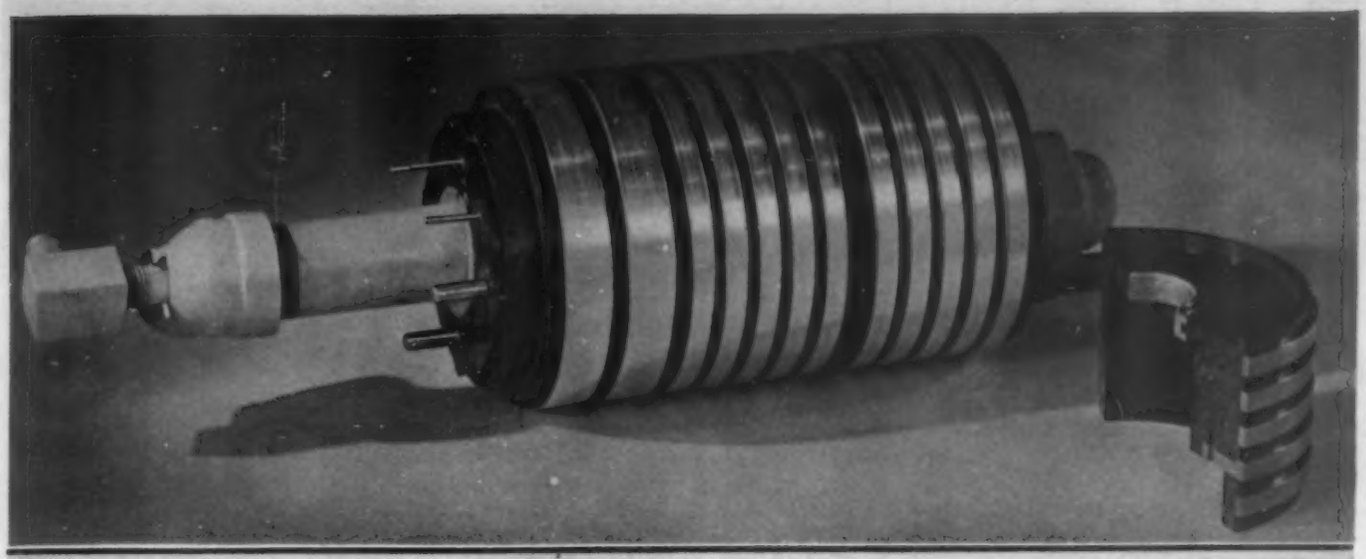
The research men who have worked with the material expect that it will come into general use for such applications as molded automotive parts, jar rings, shoe heels and soles (where it will be more durable and economical than leather), weather stripping both for buildings and for vehicles, and for impregnating fabrics. The outlook for this type of material is promising when it is realized that, during 1942, 12,000,000 lb. of plastics of the elastometer type were used as rubber substitutes and performed well in this capacity.

Plastic Foam is the name given to another of the company's new plastics, this one designed to take the place of sponge rubber used for insulation. Urea and formaldehyde are placed in a mixer and agitated at high speed to produce this light, aerated material which, when cut into blocks, looks something like snow. Described at the laboratory as nonflammable, waterproof, resilient, highly soundproof, resistant to the transference of heat, and lighter than any other known insulating material, Plastic Foam can be used in the postwar world as insulation for houses, refrigerators, airplanes and numerous other civilian products.

Members of the plastics industry who witnessed the laboratory demonstrations gave close attention to a bonding method called the Cycleweld adhesion process. A joint development of Chrysler Motors Corp. and Goodyear, the process uses a newly developed organic synthetic cement in two types of application: 1) to bond vulcanized rubber or synthetic rubber to metal or plastics and 2) to bond metal to metal, wood or plastics.

In both cases, the plastic cement is applied to the surfaces to be bonded together and cured under heat (approximately 300° F.) and pressure. Where metal is to be fastened to metal, it may take the form of an impregnated film or tape which is laid between the two surfaces before heat and pressure are applied.

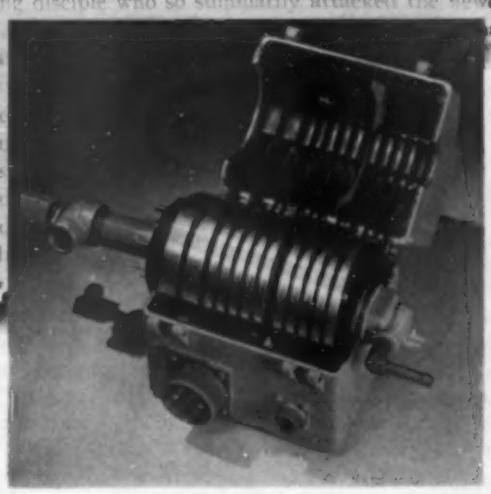
Compared to riveting or spot-welding, Cycleweld has shown superior strength both under static load and in resistance to vibrational stresses, according to reports made by technicians at the laboratory. Tests for strength showed that the bond created was stronger than the materials themselves in that metal, rubber and wood failed before the bond gave way. It is believed that the process will be used in the future for fashioning



Unlimited revolutions for gun turrets

WHEN American bombers first appeared in the European war theatre, the young Supermen of the *Luftwaffe* brashly took after them in their Messerschmitts and Heinkels, anticipating a lively killing. The big fellows, flying in majestic formation, did indeed look like easy targets—and on their way down, the Nazi masterminds had scarcely enough time to figure out just what had gone wrong!

Responsible for the abrupt demise of many a promising Goering disciple who so summarily attacked the newcomer was h... Well ... them ... Gunn... hangi... sitions ... fire fr... In ... was t... and t...



Molded rotor complete with metal plated molded plastic housing

slack length of multi-circuit cable which carries power, radio and telephone circuits. This method, however, has one dangerous drawback which has lately proved disadvantageous in the African theatre of war. According to reports, the revolving platforms on which these ... are mou... make ... turn...

• *For continuation of this interesting detailed article from a leading technical publication, write to us for free reprint.*

The 12-ring molded rotor shown above is the electrical heart which makes possible the unrestricted rotation of power-operated gun turrets in Martin patrol bombers. It transmits electric power from the fuselage to the revolving turret, connects radio and telephone circuits, and supplies oxygen for the gunners. The entire turret swivel joint, of which this rotor is a part, illustrates how plastics functional design has helped to solve a most vital problem—unlimited revolutions of gun turrets.

PM

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a multitude of articles from plastics and metals combined, and for applying thin, non-corrosive sheathings to wood for use in motor cars, furniture and building construction.

The symposium on plastics, held in the afternoon of June 22, was opened by Dr. T. S. Carswell, research director of the Plastics Div., Monsanto Chemical Co., who chose as his topic "Advances in the Thermosetting Resins." The war brought a great change in the field of plastics, Dr. Carswell said, because as the demand for light metals grew and the supply diminished, plastics were adapted to meet the needs of war production. Gun stocks, mortar fuses, rain coats, flotation gears, water bottles, gun turrets and a long inventory of other products were developed in plastic materials.

Research conducted with a view to finding new places for plastics in the war program, and experience gained in the field will both contribute to the expansion and diversification of plastics applications after the war. "It can be anticipated that, in peacetime, the thermosetting materials will primarily hold the field in structural applications, while the thermoplastics will find wide use in decorative and specialty products," the speaker prophesied.

Dr. Carswell discussed the many advances made in molding methods in the thermosetting plastics, stating that some of the new techniques are so recent that it is hard to tell just what their ultimate place in the industry will be. He emphasized, however, that work being done with new molding practices is sure to promote the search for new applications of thermosetting resins for future civilian uses.

The next speaker, Dr. D. S. Frederick, sales manager of the Plastics Div., Rohm and Haas Co., discussed the derivatives of acrylic acid and their present-day uses. Nearly 100 years had passed after Redtenbacher, a German chemist, reported a new acid which he named acrylic acid before any of its derivatives attained commercial importance, Dr. Frederick said. "While practically all the possible derivatives of an aliphatic acid have been prepared from acrylic and methacrylic acids," he continued, "those which are of practical importance at present are the esters, salts and nitriles." Turning to the esters, which have the widest applications and some of the most interesting properties, Dr. Frederick touched briefly on their preparation, characteristics, properties and polymerization before he went on to discuss their applications.

The first commercial acrylic products, he said, were originally used in the preparation of a laminated glass which was the first to show the now popular "flexible break" and to require no edge sealing. The resins now serve in such diversified applications as vehicles for luminescent pigments for paints; adhesives for wood, metal, glass, plastics (in solution); leather and textile finishes (emulsions); and moldings in the form of dials, lenses, reflector buttons, hair brush backs; and many types of decorative work.

Cast methyl methacrylate sheets form some of the most spectacular and important applications today, Dr. Frederick continued, citing a group of transparent airplane enclosures, together with industrial shields and covers, optical lenses, lighted signs and displays and "cold light" surgical instruments. While he believes that plastics will expand their field of application after the war, he cautioned against taking too rosy a view of the future. Lots of hard work lies ahead, he concluded, and full advantage should be taken of wartime experience in determining the places where plastic materials can serve to best advantage.

Dr. A. M. Howald, of the Research Div. of Libbey-Owens-Ford Glass Co.'s Plaskon Div., closed the afternoon session with a talk on urea-formaldehyde and melamine resins, in the course of which he demonstrated the ease with which these resins can be made. The trick in dealing with these resins, Dr. Howald explained, is not so much in the manufacture as in the control.

The present and future of the chemical industry was the subject of Wednesday morning's symposium, and the first speaker was Leland I. Doan, vice-president in charge of sales, Dow Chemical Co., who called his paper "Aladdin's Lamp" because, as he explained, his company had rubbed the Aladdin's Lamp of nature and caused the giants of chemical industry to rise from the sea. In general, Mr. Doan said, the chemical industry supplies the basic chemicals useful to other industries and at the same time, through research, develops special products related to these older chemicals which are also utilized by these same industries.

Plastics and magnesium he cited as examples of his company's specialties, and to explain how they came to be selected, he described the geological structure of the Midland, Mich., area, with its rich supplies of natural resources. "We have limited our activity in plastics to those which are derived from wood, oil and brine," Mr. Doan continued, "our basic raw materials," going on to explain how each of the company's three plastics stemmed from combinations of these natural resources. Remarking that each year one or two new plastics are placed on the market, he said that it is safe to assume that in a decade plastics will be perfected to the point where they will be everyday items in many fields of manufacture. In conclusion, Mr. Doan paid tribute to the men of courage and good will who, with the aid of science and industry and in an atmosphere of free competition, will in the future as they have in the past, create new jobs, new wealth and new happiness.

Mr. Doan was followed by Dr. E. R. Weidlein, director of the Mellon Institute, who took as his topic "The Future of Industrial Research." Briefly touching on the contributions made to the American standard of living by such gifted men as Edison, Bell, Ford and others, and the organizations they established, Dr. Weidlein called attention to the fact that in this time of national emergency the Government has turned to the great industrial organizations who maintain large research staffs of scientists and engineers to help solve problems related to the winning of the war.

Fundamental research carried on over a number of years has enabled industry, Dr. Weidlein stated, to provide the armed services with scientific developments sufficiently advanced to be put to immediate use. As examples he cited radar, toluol and ammonia for explosives, improved aviation gasoline, new varieties of textiles, synthetic rubber—all developed in the laboratory in peacetime. "The potentialities for the same type of advance in the future are greater than any that ever existed in the past," the speaker concluded, "and one of the most important tasks is the stimulation of scientific research in order . . . that this knowledge can be used through invention and ingenuity to create new and improved products . . . and to handle more efficiently our natural resources."

"The Development and Uses of Nylon" was the subject of the paper given by Dr. G. P. Hoff, technical director, Nylon Div., E. I. du Pont de Nemours & Co., Inc. By way of reminding his listeners that nothing is impossible to the research man, Dr. Hoff recalled the words of an eminent German authority, uttered in 1925: "Regarded from the technical standpoint, synthetic rubber is today no longer a practical proposition."

Just three years later, the du Pont company decided to expand its program of fundamental research in chemistry, and Dr. Wallace H. Carothers was brought from Harvard to work on problems of his own choosing, Dr. Hoff continued, going on to describe the results of his work, one of the first of which was Neoprene, a synthetic rubber!

Most of the early output on nylon, Dr. Hoff said, went into stockings and toothbrush bristles—until December 7, 1941, when the history of that plastic material was drastically changed. As a replacement for silk from Japan, nylon now works for the armed forces as parachute fabric, and also forms cords for bomber tires; glider tow rope; bristles for the brushes that paint ships, guns and tanks; shoe laces; and other items of military significance.

For the future, Dr. Hoff predicted literally dozens of new applications for this versatile material, applications running from sheer luxury fabrics to men's hat bands and scuff-proof shoe fabric; from upholstery fabrics to tents and sash cords; from rods and tubes to coatings and (*Please turn to page 138*)

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S.P.I. News

The first meeting of the Pacific Coast Section of SPI followed a dinner held in the Gold Room, Hotel Ambassador, Los Angeles, on June 18 with 110 members and guests attending. J. D. McDonald, director and chairman of the Pacific Coast Section, introduced George F. Russell, president of Northwest Syndicate, Inc., who gave a detailed explanation of heatronic molding methods and equipment as applied to the production of plywood and plastics molded parts. Mr. Russell, who publishes the leading newspaper in Tacoma, has organized Northwest Syndicate to manufacture and distribute heatronic molding devices, a number of which are now operating on the Pacific Coast.

Following Mr. Russell's talk, John Delmonte, technical director of Plastics Institute, conducted an open discussion on low pressure molding and laminating which brought out many of the salient points of progress these new methods have introduced in aircraft manufacture.

C. W. Armstrong, senior plastics research engineer, Lockheed Aircraft Corp., discussed the work his company has done with MR Resins in collaboration with Swedlow Aeroplastics Corp. and indicated some of the steps that have been taken to develop and determine the remarkable properties these resins exhibit as bonds for various fibrous substances, especially fiber glass.

William I. Beach, chief plastics engineer with North American Aviation Corp., was asked to tell something of his work in forming C-Stage phenolic laminates (see page 69 of the June issue of MODERN PLASTICS) which, theoretically, "can't be done." Beach indicated some of the economies this process opens to aircraft production, not only in monetary savings but in man hours and weight, which are infinitely more important to the immediate scene. Taking just one example of a plastic part which has recently been placed in production by his company, he pointed out that its aluminum counterpart was made in four separate parts which required four separate stamping operations, a like number of reworking and finishing operations and four seamwelds to complete. A time element of 1 hr. and 25 min. was involved. The duplicate plastics part is made in one piece, by one man, in 19 minutes. The performance of the plastics part under combat test is superior to that of the part it replaced.

Dr. F. J. Kreiger, Douglas Aircraft Corp., concluded the discussion by pointing out that while an all-plastic aircraft was a fallacy never likely to be realized, engineers are beginning to recognize that many component parts of modern fighting or commercial ships can employ plastics to advantage and that serious studies of these possibilities are taking place.

The program of the newly formed Section was outlined by E. F. Lougee, Chairman of the Advisory Board of Plastics Institute. Two general meetings are scheduled: one in November each year which will be open to all SPI members on the Pacific Coast as well as to engineers and others in all Pacific industries who are interested in the general subject of plastics, and the national annual meeting, inaugurated last February, which will be repeated each year.

In addition to these 2 general meetings, it is planned to launch a series of monthly meetings for members only, Mr. Lougee said. These will be for the mutual discussion of plastics problems encountered in Pacific Coast manufacturing plants where engineers and plastics suppliers and converters can take down their hair and clear up any misunderstandings and misinformation that are bound to creep into the rapid conversion which is taking place in this area. Being closed to everyone excepting members of SPI, these meetings will provide opportunity to discuss confidential matters which could not be handled in open meetings.

Membership in the SPI, Mr. Lougee stated, is available to any established concern maintaining a plastics manufacturing or converting division within its organization whether or not this division makes plastics parts for others to use. Representatives of Eastern concerns who hold company memberships in the Society are eligible for individual memberships.

• • •

The fall meeting of the Society of the Plastics Industry is to be held at the Waldorf Astoria in New York City on Nov. 8 and 9. Plans for the meeting are going forward rapidly and all indications point to one of the largest gatherings in the history of the industry. A local program committee is in charge of arrangements for the meeting. Clayton Shoemaker, Dow Chemical Co., is chairman of the committee. Other members are S. I. Howell, Mack Molding Co.; R. D. Werner, R. D. Werner Co., Inc.; Herman Lermer, Celluplastic Corp.; George Simon, Hayden Chemical Co.; Sidney Lewis, Advance Molding Corp.; Chris Groos, Boonton Molding Co.; Bernard Schiller, Universal Plastics Corp.; J. L. Herland, Button Corp. of America; and A. C. Manovill, Plastics Manufacturers Co. One organization meeting of the committee has already been held, with another scheduled at an early date. The work and arrangements will be subdivided between the various committee members with Mr. Lermer in charge of publicity, Mr. Howell, registration, and Mr. Groos, hotel arrangements.

• • •

A series of monthly meetings, all to be held at the Waldorf Astoria, has recently been announced by the Program Committee of the newly organized New York Chapter of the SPI. It is planned to include in the programs subjects which are of timely and specific interest to those engaged in plastics. While all of the subjects have been selected and arrangements are being made for speakers, there may be some deviation from the dates of the meetings as outlined in the following tentative program:

The meeting scheduled for the Sert Room of the Waldorf Astoria on Thursday, July 15, at 8 P.M. has as its subject "Job Rating and Individual Merit Rating." This subject will be discussed by C. J. Uhlir of the National Metal Trades Association, who is widely experienced in this subject. "Wage Rate Incentive Plans" is the next subject on the agenda, being scheduled for Thursday, Aug. 19. Phil Carroll, Jr., business consultant, is to be the speaker. On Sept. 16, "Load and Progress Charts" will be the subject covered by Herbert Spruway of the Boonton Molding Co., while "Management and the Foreman" will be discussed by J. M. Schappert of National Metal Trades Association at the meeting to be held on Oct. 14.

• • •

N. J. Rakas, Chrysler Corp., represented SPI at a conference held at the Navy Dept., Washington, on June 21, while George Clark, Formica Insulation Co., represented the laminators. The purpose of the conference was to initiate cooperative effort to aid the ANC subcommittee in its authorized functions and to review means and methods by which each group could aid the other on such matters as standardization, dissemination of authoritative engineering information and coordination of development and research in the field of plastics. Represented at the meeting were ANC Technical Subcommittee on Plastics, National Electrical Manufacturers Association, Laminated Products Section (SPI) Plastics Materials Manufacturers Association, Airplane Technical Committee Subcommittee, National Advisory Committee for Aeronautics, Federal Specifications Technical Committee on Plastics and the Plastics Industry Committee on Laminates. It is desired to have a central committee of the industry to which aircraft manufacturers may present their plastics problems and it is further desired to promote research on the various plastic materials available for use in aircraft in order that eventually complete engineering data will be readily available to each. The committee for the industry is to consist of W. J. McCortney, general chairman of SPI Technical Committee or N. J. Rakas, alternate; Charles Romieux for PMMA, and George Clark representing the plastics industry's Committee on Laminates.

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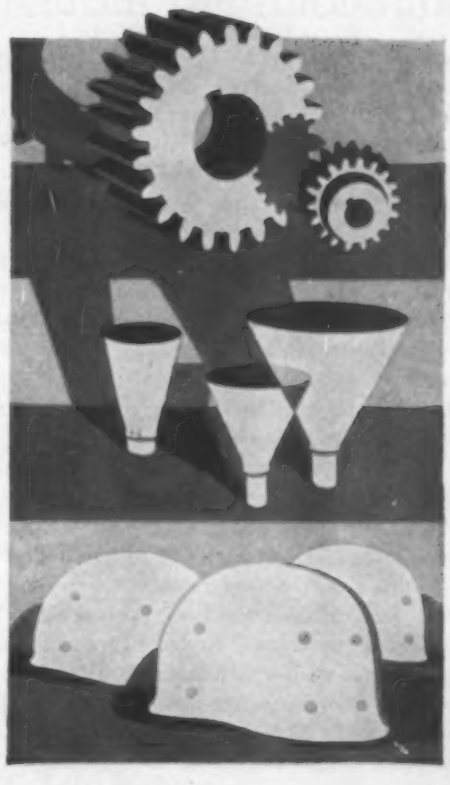

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Photolithographic plates

(*Continued from page 63*) tion comes to light. When zinc and copper plates gradually began to crowd the lithographic stone out of the photo-engraving business, it was objected that the metal plate could not carry so much ink as the stone without smudging. Now the balance has swung back, for the plastic plate will take 25 to 33⅓ percent more ink than the stone will, without smudging. So far as the number of impressions is concerned, the average lifetime of one of these plates equals that of a metal one. Also, the polyvinyl alcohol plastic inherent in the plate is an absolute grease repellent, which does away with scumming.

In explaining the uses and advantages of the polyvinyl alcohol resin plate, however, there was a particular point which Messrs. Toland and Bassist wished to emphasize. There is one job which as yet the polyvinyl plates will not do: they definitely will not replace newspaper printing, as some reporters have hinted is possible. The polyvinyl plate has been adapted especially for offset printing; newspaper printing is an entirely different process. The time may yet come when this innovation will be taken over into the newspaper business, but in the meantime the four or five thousand lithographers in this country who are wondering where their next supply of metal is to come from may well look forward to the day when an adequate supply of plastic plates will be released to them.

Credits—Material: Polvinyl alcohol, Electrochemical Dept., E. I. du Pont de Nemours & Co., Inc.; Plaskon. Printing plates manufactured by S. D. Warren Co. for Plastolith Co.

Game-founded industry

(*Continued from page 73*) molding, the white field is made. The mold surfaces are then cleaned and the black numeral and circle molded into the white field. These numbers are made in multiple cavity molds which are also chase and force molds. After the cold forming operation, the entire assembly is re-pressed in a chase and force mold to cause all of the parts to weld together.

Naturally, in a molding powder with as high a percentage of non-binder as is required for billiard balls, the problem of unmolding is serious. In all of these pressing operations there is a tendency toward stratification. This can be noted by observing a molded block after it has been standing for a week to ten days. The unmolding will start at the equator and gradually work outward.

It is necessary therefore to treat the block from the mold in such a manner as to eliminate the stress lines, which are at right angles to the stroke of the press. To this end the ball is subjected to extremely high pressure in hydraulic autoclaves. These autoclaves are heavy steel tubes surrounded by a steam jacket. In the stress-removing operation, each ball block is encased in its own small rubber bag and placed in the tube, which is filled with water under hydraulic pressure. Steam introduced into the jacket puts upon each ball in the tube a total pressure of 55 tons. The result is that a secondary flow takes place and, inasmuch as the pressure is radial and uniform about the entire surface of the block, substantially all stress lines are removed and the tendency toward unmolding is overcome.

In all of the curing operations a great deal of attention is given to the time and temperature. The flow point is quite critical, and the object is to have the entire mass arrive at the point of flow at about the same time. Obviously in dealing with the nitrate there is a tendency for the outer surface to get too hot before the inside arrives at the required temperature to bring about uniform flow, in which event an explosion will usually result. The cures are run at relatively high temperatures (on the order of 340° F.) in the presses and the short cycles run from 6 to 8 minutes. Once a given cure is established on a given stock, a matter of an additional minute or minute and a half is sufficient to bring about decomposition. In the final stress-relieving operation, it is possible to get more uniform heat transfer, so a temperature in the neighborhood of 280° F. is used and the time cycle increased to 25 or 30 minutes. Figure 3 shows a bank of hydraulic presses with the auxiliary cold forming equipment.

The blocks are then machined, using double spindle turret lathes for turning them to the exact size, ready for grinding (see Fig. 4). The experienced lathe operators work with an "educated thumb" on the cross-feed and do not need to measure the blocks to know when they have reached the precise size and shape. Measurement with a micrometer at this stage will show that tolerances are ±.002–3 inch. After they have been turned, the balls are ground in centerless grinders to the desired size and roundness within ±.0005 in. (Fig. 5). The finishing operation consists of polishing or buffing on a buffing wheel with Tripoli and a coloring compound used on the dry wheel. Then comes the burnishing operation with hard Carnauba wax for the final finish.

The inspection is very rigid. Each ball is impact tested, and auditory tests are made for internal defects. In the test for internal defects it is possible to detect fissures having areas equivalent to a spot 1/16 in. in diameter.

Because of the cost of the machining operations and the many stages involved, defective work or defective moldings can be very costly. Therefore, a very careful laboratory control is maintained over the molding powders. Each batch is sampled and sent to the control laboratory. In the laboratory (Fig. 6), measurements are made on the samples molded from each batch as to abrasion value, Rockwell hardness, shear strength, compression strength and flow.

Due to the fact that this stock has such a low flow, conventional methods of flow testing are not practical, and the flow is obtained by measuring the deflection of standard sized pills subjected to compression load after conditioning at constant temperature. From these tests arbitrary charts have been drawn up which enable us to set limits for flow as related to the abrasion value determined in the abrasion test. All the tests take temperature into consideration.

The cue balls are normally manufactured in three grades—those made from phenol-formaldehyde powder, urea-formaldehyde powder and cast phenolic balls. The manufacture of the phenol-formaldehyde and the urea-formaldehyde types very closely parallels that of a cellulose nitrate ball. The resins are made in agitated kettle reactors and the fillers are incorporated in Werner and Pfleiderer mixers. However, these molding powders are milled much finer than the nitrate powders, and all of them will pass through a 60-mesh screen. The two molding operations are practically identical except, of course, that only one pressing is necessary for the phenol and urea balls as there are no numbers or bands to contend with. The stress relieving operation takes place in the hydraulic autoclaves.

The cast phenolic balls are made by a special process and represent a problem entirely different from those we encounter in the casting of synthetic resins. Because the specific gravity of billiard balls ranges from 1.7 to 1.8, in the manufacture of the cast phenolic balls it is necessary to increase the

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specific gravity from 1.27—which is the normal specific gravity of a cast phenolic resin—to 1.72. This is done by the addition of make-weight under very carefully controlled conditions, in order that the balls will not lose the normal brilliance and translucency of a cast phenolic resin.

The balls are cast in lead molds to their approximate size and are polymerized in ovens over a period of 3 to 4 days before the usual machining operations take place. The balls are harder than commercial cast phenolics, their Rockwell hardness running from 100 to 110 on the L scale compared to the Rockwell hardness of machined resins (from 60 to 70).

Very accurate control is required in the manufacture of the cast phenolic balls, both in the handling of the raw material and in the reactions obtained when the resins are made. Careful attention must be given to the pH values and viscosities. The rate and degree of condensation of phenol-formaldehyde is measured by means of viscosity, and the final hardness and the pouring viscosity are controlled through the pH measurements. The cast phenolic cue ball is unexcelled for beauty, durability and playing characteristics.

A wide variety of games is built around the conventional carom game, and the ball sizes range from $2^1/_{16}$ in. in diameter with a density of 1.9 for English billiard balls, to 3 in. in diameter for balls used in South American games. The larger balls are usually of the phenol-formaldehyde type and present many problems in molding because heat transfer and low flow in the molding powder make very rigid control of curing conditions essential. The phenol-formaldehyde and urea-formaldehyde balls are very hard (Rockwell hardness around 100), whereas the nitrate ball has a Rockwell hardness of from 88 to 94. The colors range from deep, brilliant reds to pale pastel shades, and in all there are some 72 different varieties of balls manufactured. All in all, the game has contributed much to the building of the industry; and now the newer materials and processes, such as the cast phenolic resins, have given devotees finer and more attractive equipment.

Screens without holes

(Continued from page 64)

The raw material for this non-metal screen is similar to that used in making nylon stocking yarn. The milky white nylon chips first are pigmented, then melted at the lower end of the spinning hopper. The uniformily colored nylon polymer is extruded through a single-hole spinneret, falling into a cold water bath which solidifies it into a monofilament. It then is stretched to several times its original length while passing through a heated trough. This treatment causes the long-chain nylon molecules to line up in parallel and imparts to them high strength and elasticity. Finished at a rate of 500 ft. per min., the "wire" is wound on a reel ready for shipment to the mills.

Arriving at the mill, the nylon "wires" are unwound from spools onto the warp drum, which is then removed to the loom where the finished screen is woven (Fig. 2). Hot rollers then heat-set it, preventing subsequent wrinkle or shrink.

While this nylon netting can be spun in any color, visibility tests indicate that it is easier to see through dark screens than through those made of light or semi-transparent screening. This is due to the fact that semi-transparent nylon "wires" reflect back more light into the eyes than the dark filaments. Only where privacy is all-important are light-colored nylon screens considered desirable.

Credit—Nylon screening developed by E. I. du Pont de Nemours and Co., Inc.

Aircraft applications

(Continued from page 90) use of low-pressure molding techniques will permit the application of plastics to stressed parts. Only by the use of low-cost moldings can the fabrication of compound curvature parts be economically accomplished in the limited quantities needed for aircraft. When forms are likely to be changed every few hundred airplanes, the use of low-pressure resins and readily formed molds such as Kirksite, wood or plaster lends itself to economical production. The value of such techniques is being proved every day as new applications appear.

All of the present applications of high-strength paper-base plastics have been molded at 250 p.s.i. or lower and on molds made from one of these easily formed materials. The fuselage access door for an advanced trainer type airplane was readily reproduced in paper through the use of a Kirksite mold.

Low-pressure molding has made possible the use of the hat press and molds similar to those now in use by this industry. Various types of fillets have been made by this method for advanced training type airplanes with excellent results. One possible problem in this work is the maintaining of proper contours which have to be drawn to shape. Proper tailoring of the cloth can eliminate this trouble on production parts.

A few secondary structural parts have been made by high-pressure molding. Three examples are the wheel fairing, navigator's hatch and escape door for a heavy bomber. Each of these has been molded of phenolic laminate using the conventional molding operation and pressures. The use of such a technique can only be justified, however, by a permanent part on a high-production airplane.

Under the broad heading of secondary structure are also many of the transparent inclosures and windows necessary to provide adequate vision for the crew members. Here the present-day applications are well known, but the needs of the future are rapidly being forced upon us. New materials are needed to permit the installation of adequate windows with proper optical properties in high altitude, pressurized cabin airplanes.

Applications of plastics to structural parts of airplanes have been few. Some attempts have been made to build primary parts, but with the available materials, nothing can be built to compete with the metals now used. As has been shown in previous discussions, the necessary mechanical properties have yet to be obtained. This is reflected in the design of most structures which have been built. All have been overweight where stressed units were considered. The flaps which were built for the training airplane were 30 percent heavier than the part then in use.

An attempt to design a wing structure using high-strength paper-base laminates is now under way. For this project, the load-carrying structure of a training airplane wing has been redesigned for the same loads using laminated construction. This wing box will be tested in the near future, and will attempt to prove the possibilities of proper design for plastic material construction. Here again the rapidly changing state of plastic development has caused the material employed to represent what are possibly the minimum properties to be found and not the best now available.

With the development of new materials possessed of the mechanical properties outlined in previous discussions, the extension of plastics to design of primary structures will be rapid. Only by the attaining of these properties can the most efficient plastic structure be built to compete with a metal unit.

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on the Supply Lines

Protek Plugs, illustrated, are molded by Bridgeport Moulded Products, Inc., for Chandler Evans Corporation. Cycle: 90-100 per hour. Material: Butyrate.

Guarding aircraft engines from factory to airplane "fly-a-way" against dust and moisture is a job well done by the dummy spark plugs illustrated above.

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Resin-pulp preforms

(*Continued from page 77*) of notch. This is approximately 40 percent above the impact strength of molded macerated-fabric-filled compounds. At this same resin content, the flexural strength is 80 percent greater and the tensile strength 100 percent greater than the tensile and flexural strengths of macerated-fabric compounds molded in the same mold and tested under identical conditions. As previously pointed out, the pulp-resin preform is readily moldable at 35 percent resin content, and gives articles comparable in appearance and water resistance to the molded high impact material.

Comparisons of the physical properties of several pulp-phenolic resin preforms containing 55 percent resin, and two of the standard high impact compositions molded in the same mold are given in Table II. This tabulation also indicates the influence of the type of filler and the advantage of fiber formation or lay-up on the mechanical properties. The use of macerated fabric alone or in conjunction with the kraft pulp greatly improves the impact strength without markedly altering the tensile and flexural strengths of the all-kraft pulp material previously discussed. Preliminary investigations also indicate that the same type of curve as shown in Fig. 4 will be obtained by varying resin content with these fillers. Thus we can expect tensile and flexural strengths nearly double those of present molding materials, and impact strengths equal or superior to the best grade impact materials.

Although still in its earliest stages of development, the many outstanding characteristics of pulp-resin preforms are creating widespread interest in this process. The material is easily molded, possesses excellent physical and mechanical properties, and presents economic advantages which favor its acceptance. Mass production methods may be applied to the process to produce large pieces, reducing overhead and production costs. A number of well known concerns are already starting in this field and indications are that many others will quickly follow.

Postwar research

(*Continued from page 70*)

Greatest justification for use of plastics has been the design possibilities. On a pound basis, even with mass production, the prices of plastics probably never will match those of metal, but by designing a piece so less assembly work is necessary, the comparative cost factor is overcome.

When plastic parts are molded to duplicate metal parts exactly, and when they must be fabricated afterward, the cost is high and advantages less. Consequently, plastic materials and processes which lend themselves to intricate design (often with metal parts embedded, or even, in laminates, with metal sheathing on the surface), will be the ones that, in actual use, will develop most rapidly.

Use of plywood and compressed wood, and use of wood as a laminating material unquestionably will grow far beyond any present-day demands. The development of low-temperature phenolic curing resins (from room temperature to 150° F.) already has been achieved. This eliminates many of the troubles of hot pressing and assembly gluing, and wood so laminated or glued can have controlled directional strength with light weight. With the new plastic adhesives, fixtures of metal may be bonded directly without bolts, overcoming the old trouble of parts loosening as a result of lack of bearing strength. Wood not only has strength with low weight but rigidity with low weight. Veneers of wood bonded with the newer types of thermosetting plastics lower the naturally occurring uniformity of wood.

Combinations of wood, cloth, metal and fiber laminates are in production. This outlet for plastics is very promising. But here again many problems must be studied to gain the maximum achievement apparently possible.

In the thermoplastic field, polystyrene seems to me to be due to hit mass production first. Improvement in heat resistance, or dimensional stability of the thermoplastics, is coming rapidly but only in degree. There remains an immense increase in market for higher softening point materials with greater strength, particularly for plastics which are inherently plastic without the use of abnormal amounts of plasticizer. There is, of course, a lot of research going on in the thermoplastic field. One concern has developed a thermoplastic material, a sulfur dioxide olefin resin, which has plenty of promise behind it.

Synthetic rubbers are really plastics, and all kinds of types will be possible through the knowledge of copolymerization which we have obtained in this field.

The specialty fields are too extensive to cover in a brief review. Bonding of fibers for insulating boards and materials is an ever-increasing field. Better brake lining resins already should be possible with the knowledge gained through war work; the adhesion of metal parts with plastic cements unquestionably will replace many riveting and hand welding jobs. The electrical fields need many new products suitable for high frequency and, while progress seems slow, developments are coming with a speed difficult to follow.

As to the availability of supplies during the war, I think an increase in the production of raw materials is in the making which will have a corresponding effect on the amount of material available for plastic processes. Probably not until the first of 1944 shall we see this. I do not believe there ever will be enough plastic raw material available to the industry to meet all demands during the war, but I do think that the amounts allowed in all fields will increase by 1944.

Molding and fabricating costs today are almost as great as and sometimes greater than the materials themselves. However, through utilization of lower pressures much progress is being made in this field to pare down mold costs. This trend applies also to methods of making the molds and to equipment for more rapid molding such as injection molding machines for thermosetting materials. In this connection, bag molding techniques of the rubber industry have been shown to be practical in plastics.

While we all know that continuous extrusion of thermoplastics into tubes, rods, etc., is a fact, are we all aware that continuous production of thermosetting pipes and tubes also is a practical possibility? The mechanical end of the plastics art has even more room for progress than the chemical. Each gain in this phase of the industry will open up more and more fields for all other phases.

Nothing has been said about the new, lost-cost types of products from lignin, cellulose, proteins, terpenes and other inexpensive raw materials, but these unquestionably will develop cheaper sources of resins and chemicals for resins. As our economy changes, low temperature distillation will increase and more cresylic types will be available. In connection with this phase of plastics, it might be explained that by a process of low-temperature distillation of coal we get a much higher yield of phenolic material than is obtained by higher

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temperature coking, a fact which I believe is not too generally appreciated. Low-temperature coking has been a practice in Germany for years with the result that they have produced great qualities of phenolic material for plastics. They also go in heavily for hydrogenation of natural oils to produce their aviation fuel.

In this country very little has been done in this field chiefly, I suppose, because of the availability of cheap oil. At some future time, however, when our supplies have reached production peak and are on the way down as to adequate supply, this low-temperature coking feature may very well play an important role in our total economy picture. If this does come to pass, it opens up an entirely new source of raw materials for plastics. This in turn may be interpreted to mean a possible change in the phenol makeup since we obtain a different by-product when we produce phenol by the low-temperature process as compared to the high-temperature coking—a change for the better perhaps. We get another angle of this picture when we consider that fuel produced by this form of coking is rendered smokeless. The demand for smokeless fuel will come again after this war in urgent calls from those who have to live, work and play in areas affected by heavy smoke palls.

The synthetic fiber is just beginning. There is no reason why the creation of new types of plastics should for long be handicapped by high-priced raw materials. Basic plastic research of all cheap sources of materials already has gone far. As demand for further chemical material increases, further research will supply them.

So it is safe to say that the usage of plastics should grow by leaps and bounds if far-sighted management is used and if the present-day business is regarded as just a start, not an end. Under our American system of competitive business, together with good research, it seems reasonable to expect that the plumbing fields, the house furnishing field, the automotive, refrigeration, railway equipment and business-machine fields all will be big users of plastics—and soon.

A.S.T.M. Committee D-20

(*Continued from page 94*) Nonrigid Ethyl Cellulose. Under consideration are specifications for all other plastic materials in commercial use.

Subcommittee VII on Analytical Methods (P. D. Brossman, chairman) was organized shortly after the last annual meeting in response to a large number of requests for standard test methods for the analysis of plastics. The need was especially brought out by the work of Subcommittee VI on Specifications.

Although less than a year old, Subcommittee VII has already made considerable progress on test methods for methanol soluble content and viscosity of polystyrene and on a method of determining acetyl and butyryl content of cellulose acetate butyrate. It is actively engaged in tests on cellulose nitrate, methacrylates and chlorine containing resins. Also under consideration are methods for determination of plasticizer content and specific gravity.

Subcommittee VIII on Research (H. K. Nason, chairman). The topic of research has been a lively subject of discussion with Committee D-20 for a number of years. In order to clarify the situation, Subcommittee VIII on Research was set up at the October 1942 meeting. The organization was completed shortly thereafter and the subcommittee has now chosen its first project. Strength under impact, involving all phases of impact testing, will be studied, and the program is now being organized.

Subcommittee IX on Molds and Molding Procedures (Wm. L. Hess, temporary secretary) was organized at a meeting on June 4, 1943, in New York. In addition to members of Committee D-20, this subcommittee has on it molder representatives from the Society of the Plastics Industry. This subcommittee is charged with the development of standard molds for producing test specimens and with the standardization of conditions for molding test specimens from the various types of plastics. The dependence of test results on these two factors has been a continuous source of discussion in the subcommittees of Committee D-20 since its formation.

Housewife's helper

(*Continued from page 67*) mitted a shortening of this part and of the cylinder. Ring gates were used on the pistons to insure a uniform flow down the piston and to eliminate bond lines and strain release which tend to make the parts egg-shaped after immersion in liquid. A simple side-operated cam was used for the coring of the nozzle cavity in the head. Very small parts were located close to the sprue, a factor eliminating large gates with a consequent decrease in finishing operations. Finishing, assembly and testing of the plastic parts was done in the plastics division of the manufacturer's plant.

Not confined to glass cleaners, these applicators can also be used for spraying disinfectants and deodorants in homes, theaters, hospitals, trains and airplanes; for the dispensing of food and medicinal products; and for liquid metal cleaning solutions in industrial plants. When the sprays are used as oilers, flexible tubing on the spout provides an accurate measurement of the lubricant and ensures its reaching relatively inaccessible places.

As a result of the changes made in die layout and insert design when the third die was engineered, speed of production was stepped up far beyond the expectations of both molder and manufacturer; and the thermoplastic unit has proved practical, economical, and appealing to the housewifely eye.

Credits—Material: Vinylite. Molded by Modern Plastics Co. for Wilco Co. Design developed by the two companies with the cooperation of the research departments of Union Oil Co. of Calif. and Drackett Co.

A handful of power

(*Continued from page 55*) hands from excessive heat, cooling of internal parts is accomplished by the installation of an oversized fan. Ribs on the handle form intake vents while others on the field case serve as exhaust vanes.

All 5 plastic parts are injection-molded in 2 combination molds. One mold produces the field case and handle. The cycle is 55 sec. and the complete shot weighs 5 ounces. The gear case, trigger and handle cover, produced in the second die in a 45-sec. cycle, weigh 2 oz. in all. Except for removal of the gate, minor buffing operations and the drilling of one hole and a milled slot in the handle, no machine work is required on any of these pieces.

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The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

work in shipyards, aviation plants and other war industries where fast drilling is essential, the tool is subject to sudden, sharp blows. The cellulose acetate butyrate material has been tested for its resistance to such treatment, found to have excellent impact strength and to compare favorably with aluminum as to tensile and flexural strength.

To a worker, particularly one new to the job, comfort and safety are prime requisites in a tool. While this drill, like all electrical equipment, is grounded, the dielectric properties of the plastic housings furnish added protection against shock. The resiliency and texture of the plastic casing, resulting in a cool, pleasant-to-handle tool, combine with the lightness of the assembly to reduce fatigue and speed production.

For the past year these plastic drill housings have been produced exclusively for the Army. To meet military requirements, the housings have been olive drab with a dull finish. Now that the tools have been released for use in war industries, they are being molded of maroon plastic with a high glossy finish.

Credit—Materials: Tenite II. Molded by Anfinsen Plastic Molding Co., for Independent Pneumatic Tool Co.

Liquid phenolic resins

(*Continued from page 66*) workers, who would not be allowed to lift it if metal were used.

It is not to be construed that the plastic is a cure-all and a material that can be used to replace metal in all cases. There are many tooling operations that are not satisfactorily handled by liquid phenolic resins. If a tool is to be subjected to high impacts or rough handling, especially if it has small cross sections in any place, the material is likely to prove unsatisfactory, although in a good many such applications the parts of the tool having contours difficult to fabricate are of such thickness that the liquid phenolic can be used. The parts of the tool that are somewhat thin in cross section quite frequently can be cut from metal or from laminated phenolic paper stock, a procedure which has proved satisfactory in several tooling applications. For example, Fig. 5 illustrates a plastic drill jig with a hold-down section fabricated of laminated paper stock. The hold-down section is subjected to shock and bending stresses which makes the advisability of using the liquid phenolic resin questionable. To solve the problem, the base of the jig, which would be relatively expensive to fabricate of laminated sheet stock because of its many contours, was molded of liquid phenolic resin. The hold-down section, which is easier to make and requires a high impact strength, was fabricated of the phenolic laminate.

The liquid phenolic resin is not a solution for the small company or the company with a small tooling program because it has not been found economical to set up a plastic tooling department when very few tools are required. For this reason, several engineering companies have taken up plastic tooling for outside organizations, thus solving for them the difficulty of amortization of the cost of a tooling department.

A third limitation of the plastic material has been observed where very close tolerances are required on dimensions in a plastic tool. The coefficient of thermal expansion of the plastic is 9.3×10^{-5}/° C. when pure resin or an organic filler is used. Asbestos-filled plastic has a coefficient of thermal expansion of 2.7×10^{-5}/° C. This can conceivably cause small discrepancies in the relative sizes of the tool and the parts that are being made on the tool if large ranges in temperatures are encountered in the plant. In addition to this, the aging shrinkage of the plastic may in some cases be too great for very close tolerance work.

In all instances where these limitations do not apply, however, the use of liquid phenolic casting resins for tooling has several advantages: it can be set up with inexpensive equipment; it requires a limited amount of floor space; the labor costs are low; and it can be put into production on tools within a few days—a factor in these days when speed is so essential.

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Plastics from redwoods

(*Continued from page 92*)

In no sense can this be considered as the final step in the development. Research leads to more research, and it would appear that in the relatively short time since the analyses of redwood made in the spring of 1937, just six years ago, considerable progress has been made in pointing to one way in which the great woods wastes in the redwood operation might be more effectively utilized.

The visible result of the plastics research has been the construction of a plant at Scotia, Calif., which has a maximum productive capacity of two million pounds of plastic pulp a month. The product has been going successfully into steering wheels on a commercial scale ever since the war cut off the supply of rubber and limited the supply of other plastics. The steering wheels are made by the Sheller Mfg. Co. from a redwood plastic pulp composition termed by them "Shellerite."[1] Without their work in the practical phases of the development, particularly with respect to the conversion of the pulp to a thermosetting composition and its use, the project would be very much behind its present position.

[1] "Steering with Redwood Wheels," MODERN PLASTICS *20*, 77 (Jan. 1943).

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Resistance of laminates

(Continued from page 84) use of a low resin content but at a sacrifice of chemical resistance. Mechanical characteristics are also influenced by the form of the filler used. In intricate design products the filler consists of chopped pieces, resulting in sacrifice of strength, particularly impact resistance.

The initial cost of the laminate may in some cases be the main factor deciding the material selected. Fiberglas laminate, for instance, is relatively expensive compared to cotton cloth-base laminate, and unless high mechanical properties are necessary, cotton cloth laminate should be used. If maintenance cost is low or if the product can be easily installed, it may be better in some cases to select a material with high mechanical properties, sacrificing the chemical resistance properties.

In the development of materials to resist corrosion, it is impossible in most cases to reproduce plant processes in the laboratory. Test data obtained in the laboratory can be relied upon to indicate whether or not a material will be suitable, but the best and only truly reliable method is an actual test run on a commercial scale. In the adaptation of corrosion resistant plastics to the requirements of a particular industry, it is necessary to have complete cooperation of the manufacture and the user.

18

19

Laminated plastics have traveled the seven seas as marine stern tube bearings, pintle bushings, piston rings, valve seats and pump valves. In the stern tube application, the plastic material has less swelling, reduces scoring of shaft liners, reduces power input and provides other advantages not gained by use of lignum vitae.

Typical applications of laminates

Compressor rings of laminated plastic are used in ammonia compressors in refrigeration, and in the petroleum industry for handling gases such as propane, butane and pentane. Much trouble had been experienced with cast iron piston rings previously used in these compressors. This had been caused by thinning out of oil used for cylinder lubricant, scoring of cylinders, overheating, excessive power consumption and rapid wear of the rings. These difficulties have been overcome by the use of the phenol-resin laminated plastic.

Laminated plastics have a multitude of uses in the paper industry, where they have proved superior to other materials. Being resistant to the weak acids and alkalies present in "white-water," laminated suction box covers outlast those made of wood or other materials previously used. Doctor blades, bearings, table rolls, toe blocks and shake springs are other applications using laminated plastics.

In electroplating, the work to be plated is hung from frames suspended in baskets, or enclosed in revolving perforated "barrels" and immersed in chemical solutions, acid or alkali, depending on what metal is to be applied. Plating barrels of laminated plastic wear longer than the wooden barrels previously employed. The low absorbency of the plastic affords better electrical insulation with lower current loss from leakage and increased plating speed. These plastic barrels last over a year in cadmium plating, over 5 years in plating copper, and even longer in plating nickel.

Phenol-resin laminated bearings are used for turbine well pumps, replacing rubber and bronze previously used. The laminates contribute chemical resistance, longer service life, lower cost and insulating qualities which prohibit galvanic action. In addition, bearing "change-overs" are eliminated; the material works equally well with oil or water lubrication.

Hold-down rolls made of laminated plastics are employed to advantage in pickling tanks in the steel industry. The

18—Laminated plastic pipe used in industry where resistance to water, oil and chemicals is required. 19—Plastic washing drums are resistant to corrosive liquids and water. 20—Revolving laminated plastic barrel for nickel plating

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20

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TABLE IV.—CHEMICAL RESISTANCE OF FIBER GLASS LAMINATE COMPARED TO COTTON CLOTH LAMINATE

Laminate	Days immersed in 10% H_2SO_4 at 50° C.	Percent decrease in tensile strength	Percent decrease in impact strength	Weight increase	Thickness increase
Fine weave cotton cloth laminate (full laminated)	30	10.0	34	1.2	0.20
	60	16.0	38	1.2	0.30
	90	18.0	40	1.2	0.35
	120	21.0	42	1.2	0.35
	150	22.0	43	1.2	0.35
Fiber glass cloth laminate (full laminated)	30	11.3	13.2	1.8	1.4
	60	17.5	14.4	2.7	2.6
	90	20.2	15.2	3.2	3.7
	120	21.3	15.6	3.5	4.6
	150	21.6	16.0	3.8	5.5

rolls are completely sealed to eliminate the possibility of the pickling solution getting to the inside surfaces, and thus only their outside surfaces can be attacked. The initial cost of these rolls is approximately the same as that of the usual rubber-covered steel roll.

In the rayon industry, laminated plastics are used in many ways. The outstanding application is the rayon spinning bucket that must be resistant to 10 percent acid-salt solution and must be designed to withstand the severe forces created when traveling at 7000 rpm.

Engines have brains

(*Continued from page 54*) production of the part with this material, and the sawdust method was found to be most efficient. The heads remain in the sawdust for two hours, when they are removed, dusted off and passed to the machining department. A rubber wheel cuts off the sprues, and the heads are spot faced to surface.

The head is then placed in a turret lathe which turns the outside diameter, bores the center insert and machines the contact points. The outside circumference of the head is shaved to exact dimension, and the electrodes inside are cut down so that they are equidistant from the center. When the round electrode tips are cut back, they are left in a half-moon shape, so that the finger point makes contact on the flat side (Fig. 8).

The part then passes to a drill press, which bores spots in which numbered inserts identifying the cylinders will be placed later. In a second operation, a tapping machine threads screw holes in the molded inserts. In the center of the distributor head the workman places a white lead and turpentine lubricant into which he dips the tap before tapping each hole. Screws will go into these holes to secure the electrodes to wiring plugs inserted on the outside of the head.

The heads are checked over at an inspection bench for burrs and rough edges, and here also workmen insert the small plastic cylinder numbers in the prepared holes on the outside of the head to designate the cylinder which is to be linked to each insert (Fig. 9).

After final manual inspection, the head is taken to a special dielectric test room where, in a battery of special machines, each electrode is tested with 12,000 volts. The test consists simply of an attempt to pass 12,000 volts from the even-numbered electrodes through to the next nearest, or odd-numbered, electrodes. Each electrode is thus tested in rotation, each being forced to withstand the full current for 10 minutes.

If they pass the gruelling production test—and few are found defective at the plant—the heads are o.k.'d and packed in special containers for shipment either to the company's aircraft engine plant for installation or to some sector of the fighting front for replacement purposes.

In addition, heads are selected at random and taken to the engineering laboratory where they are subjected to high temperature dielectric and arc resistance checks. These heads are subjected to 180° F. and 12,000 volts for one hour, and any defects are reported immediately to the production department.

The arc resistance test consists of passing an arc of 15,000 volts at 12 milliamperes over the skirt of the head while it is rotating at one revolution per minute, and this test continues for three hours.

The production process on the rotor, the small but equally important second dielectric part of the distributor, is quite similar. The melamine-formaldehyde compound is used for this part also, in the shape of tablets, preheated in an oven to 180° F. Rotors are molded 4 at a time (Fig. 11) in a 4-cavity transfer mold, but the process is less exacting than that for the head because each rotor contains only two inserts —one of Monel and one of brass. The press cycle on the rotor is 8 minutes, and the part spends 4 minutes in a curing press. The flash is trimmed, the part faced off and bored, and the diameter of the vital contact point turned. After passing manual inspection and dielectric tests identical to those for the head itself, the rotor is then ready for shipment.

Exacting though it is, the distributor molding job is taken in stride by the company's plastics department, which is proud of the fact that it is currently molding more than 100 items—at least one for each of the many machines of war that the plant produces.

Credit—Material: Melmac. Molded by Ford Motor Co.

Goodyear laboratory

(*Continued from page 122*) films. He expects plenty of competition for nylon, which is not cheap (although its cost will drop as volume increases). He does *not* expect much competition from silk from Japan!

The luncheon speaker was Dr. Harry N. Holmes, head of the Chemistry Department of Oberlin College, and a past president of the American Chemical Society, who stressed the rôle of university research in wartime, commenting that such work is, in many instances, supported by industry and financed by Government and that "academic remoteness will never be the same again." After the war, Dr. Holmes said, there will be as before, work in pure science, but greater emphasis will be placed on problems relating to the national strength. The combined research powers of university, industry and Government, he thinks, will be needed for the development of greater national independence—not isolationism but what he called "war insurance." Observing that in 1941 we consumed ten billion dollars worth of products unknown before 1918, Dr. Holmes left it to his listeners to decide whether research pays.

The Wednesday afternoon symposium was concerned with the present and future of transportation, with Dr. Jerome C. Hunsaker, national chairman of the Advisory Committee for Aeronautics, as the first speaker. Dr. Hunsaker's subject was "Research and Postwar Aviation," and he prefaced his talk with the observation that in aviation, isolation is technologically impossible. In the extensive international air traffic which will

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This Press is much more rapid in operation than the old-style hand pump reciprocating type. No check valves to leak.

Electric Hot Plates 9-5/8" x 9-5/8", with dual thermostat controls, accurately machined and faced with polished stainless steel or Monel.

Plates air cooled by connection with compressed air line, for rapid dissipation of heat when desired.

Especially adapted to Plastic Research—Laminations and Impregnations of Cloth, Paper, Plywood, forming Badges and Identification Cards, enclosing Photographs, etc.

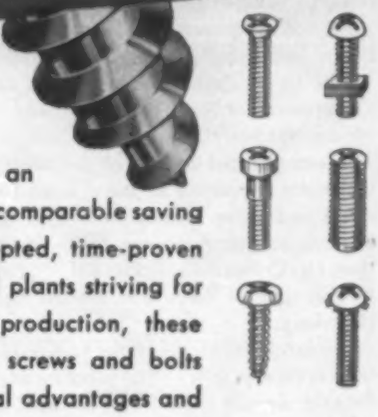
WILLIAMS APPARATUS COMPANY, INC.

Watertown *New York*

Builders of Hydraulic Presses for Twenty-Five Years

HOLTITE —Phillips— RECESSED HEAD SCREWS & BOLTS

Effect Savings In ASSEMBLY TIME UP TO 50% and more



Yes, HOLTITE-Phillips Screws and Bolts cut assembly time an average of 50% with a comparable saving in cost. Now the accepted, time-proven fastening practise in all plants striving for smooth, uninterrupted production, these modern recessed head screws and bolts provide many additional advantages and improvements. Power drivers can be used on more jobs . . . Pilot holes eliminated for stronger fastening . . . Easy driving in difficult positions and angles . . . Fewer screws required, or smaller sizes used on same operation. Other definite advantages are obtained from HOLTITE-Phillips fastenings to improve your assembly and speed production. Specify HOLTITE on your next order.

Specials

With complete equipment and facilities for producing Special parts and fastenings, we can efficiently meet any requirement, exact to specifications. Send blueprint, specifications or sample.

CONTINENTAL SCREW COMPANY

New Bedford, Mass., U. S. A. BUY MORE BONDS

follow the war, he said, competition will be keen, and a coordinated research program will reward the country that adopts it.

Improvements in airplane performance Dr. Hunsaker discussed under the following heads: *size*—not to outstrip developments in engines, landing gear and landing fields; *engine size*—beyond 3000 hp, the combustion gas turbine may be the solution; *propellers*—present designs adequate, but more powerful engines may present a problem; *engine weight*—not much hope for lighter engines, since refinements tend to add to their weight; *structural weight*—plywood, reinforced plastics, magnesium sheet and the lighter alloys and design changes should make a 20 percent reduction possible; *aerodynamics*—better designs will effect some improvement; *fuel economy*—possible gain in specific fuel consumption of the order of 20 per cent, due to better fuel, direct injection, and utilization of waste heat in engine exhaust; *general design*—tailless planes and helicopters offer the most promise of radical departure from the conventional monoplane; *safety*—research will continue to promote it.

All such improvements will be brought about, Dr. Hunsaker concluded, by industrial research supported by private enterprise.

Dr. A. B. Culbertson, manager of the Product Application Department of Shell Oil Corp., was the next speaker, choosing for his subject "Petroleum's Contribution to Transportation." The complicated nature of petroleum, and the discovery that molecules remaining in the residue from the distillation process could be further broken down into fuel for internal combustion engines, produced gaseous forms of simpler molecular configuration, Dr. Culbertson announced. "These gaseous hydrocarbons," he continued, "have become the building blocks of petroleum chemistry."

Research on high octane materials has opened up new fields with regard to lubricants, solvents and special organic chemicals, he said, among them butyl alcohol, acetone, iso propyl alcohol, allyl alcohol, ethyl alcohol, methyl ethyl ketone and other chemicals, all of them important to the plastics industry. Research he characterized as "unlocking the great storehouse of chemical compounds known as petroleum," and making its components available to all industries able to use them.

The ceremonies ended Wednesday night with a dedicatory dinner at which the speaker was Major General G. M. Barnes, Chief, Technical Division, Office of the Chief of Ordnance, War Department. After outlining the position of the Ordnance Department in the Army—that of a link between the soldier in the field and the scientist, manufacturer and engineer at home—General Barnes spoke of the research work done by Ordnance in cooperation with industry, the Navy and the National Defense Research Committee.

To give his listeners some idea of Ordnance equipment and its use on the field of battle, General Barnes took them on an imaginary tour of North Africa, describing the Ordnance items in use and the results that could be attributed to them. Of particular interest was his discussion of the bazooka, America's new rocket gun, which will destroy Germany's heavy Mark VI tank.

Coincident with the dedication ceremonies was the Goodyear Co.'s announcement of the election of Dr. R. P. Dinsmore, veteran company scientist, as vice-president in charge of research and development. This development program, when the war is over and planning for peacetime living is organized, should produce a multitude of new products, some of them not even thought of today, which will contribute to the comfort and welfare of citizens of the postwar world.

Washington round-up

(*Continued from page 114*) discussed recently by Stephen Harrington, of the Printing and Publishing Division of the WPB in a speech before the conference of International Association of Printing House Craftsmen, at Montreal, Canada.

"The pressure of global war, and its terrific drain on critical materials like metals, is about to introduce into printing, through the use of plastics, sweeping changes in the graphic arts industry," Mr. Harrington stated. He further stated that the use of plastic materials for printing purposes is almost certain to revolutionize peacetime methods in printing, lithography and gravure, because plastic paper plates are perfect substitutes for critical metals, less costly than metals, and much lighter in weight. (One type of plastic plate is described on page 62.)

CEILING PRICES FOR INDUSTRIAL CASEIN

Producers' ceiling prices for industrial casein were raised 3 cents per pound by the OPA June 16, 1943, to encourage the sale of skim milk from farms for use in producing the casein which is needed in the war program. The ceiling prices for wet and dry curd casein established by OPA range from 18 to 22½ cents per pound. The ceilings for industrial processed casein of different types range from 24 to 25½ cents per pound. Prices are f.o.b. the place from which the seller ships to the buyer. Provision is made for quantity discounts and for the addition of the lowest freight charges when the price quoted is a delivered one.

WPB FORMS IDENTIFICATION SIMPLIFIED

A simplified system of identifying WPB forms is being put into effect as present stocks are exhausted and reprinting becomes necessary, according to a recent announcement of WPB officials. All forms in the WPB, PD, UF and RD series and many in the CMP series which must be filled out and returned to WPB by manufacturers and others will eventually bear only the initials WPB, followed by new serial numbers. Each form, as it is renumbered, will carry both old and new designations until users become familiar with the new identification.

ETHYL ACETATE AND ISOPROPYL ACETATE

Ethyl acetate and isopropyl acetate went under allocation under M-327, effective June 7, 1943. Manufacturers will apply for material on form PD-600, users on form PD-601. Orders of not more than 54 gallons a month will be exempt.

TEXTILE PRIORITY PATTERN AFFECTS LAMINATORS

With certain clearly defined exceptions, all outstanding ratings for the procurement of textile products and raw materials were cancelled June 1, 1943. Henceforth, the only rating which will be valid are: 1) those already assigned or to be assigned in the future for procurement of items for ultimate delivery to the Army, Navy, Maritime Commission and the War Shipping Administration; 2) those certified on orders from Post Exchanges and Ships' Service Stores; 3) those assigned by M, P, or L orders specifically exempted from the June 1 cancellation or ratings. These orders include M-134, which assigns an A-2 rating for specific fabrics for industrial cloth, tape, surgical dressings, etc.; 4) those assigned by WPB to a specified applicant on a form describing in detail the item, type and quantity of material which may be purchased with the rating. Authorizations issued prior to June 1 fulfilling these requirements are still valid. The order (M-328) cancels all other ratings now assigned or authorized if they have not yet been applied for procurement of specific items.

This move will have several significant and immediate results. It puts military and certain essential civilian claimants for textile and leather products at the top of the priority list, and permits the operation of a free market in procurement of those products for all other purposes. As a result, once producers and distributors have met the most essential demands, they are given the opportunity of distributing their output and stocks to all other purchasers. The order requires that when specific permission is requested from the WPB for a rating, complete information as to what the fabric or leather product is to be used for must be provided, including such facts as the name of the person to whom the rating is assigned and the yardage, type, construction of fabric, quantity of fabric, etc., is to be procured.

THERMOPLASTIC MATERIALS

PLASTIC MATERIALS

HEADQUARTERS for reclaimed thermoplastics: Acetate, Butyrate, Styrene, Celluloid, Acrylic and Vinyl Resins.

LEADING THE FIELD FOR MORE THAN 20 YEARS

WE RE-PROCESS *for* YOU—OR BUY *from* YOU: We reclaim thermoplastics that are off-size or off-standard, including factory residues or scrap.

TURNING WASTE INTO USABLE MATERIAL: We are a source of supply for manufacturers who need clean and graded re-processed plastics. These are suitable for many applications where VIRGIN materials are not essential or CANNOT BE OBTAINED!

Write for details—

GERING PRODUCTS, INC.

NORTH SEVENTH ST. & MONROE AVE., KENILWORTH, N. J.

CHICAGO OFFICE 622 MONROE ST.

Time Saving

DME STANDARD MOLD BASES

PATENT APPLIED FOR

Speed the job—from designing board to production—save precious preparation time and labor. Advance the starting time of production at least a week. Reduce costly errors and produce more uniform results. Immediate delivery—all sizes most generally used—complete—ready for you to insert cavities, ejector pins and water lines. Over half the component parts can be used again for subsequent setups (more time and materials saved)!

Acquaint yourself with the latest developments in mold engineering—our new catalog is yours for the asking.

★ ★ ★ ★ ★ ★ ★ ★

You can buy a $100 War Bond on what you save on each DME Standard Base you buy.

DME

DETROIT MOLD ENGINEERING COMPANY

4837 WOODWARD AVENUE • DETROIT 1, MICHIGAN

Molded for the Marines

. . . TO SAVE VITAL METAL

AGAIN plastic replaces a vital wartime metal. From the Halls of Montezuma to the Shores of Tripoli the Marines are proudly wearing their new *plastic* emblems.

Molded of cellulose acetate butyrate, they will withstand climatic conditions from freezing arctic cold to simmering tropic heat. And, Aico's injection molding is keeping step with the needs of the rapidly expanding Marines.

To produce this part speedily and economically, Aico molders drew from their knowledge and skills gained in 26 years' of plastic molding . . . knowledge and skills which in peacetime will help to continue the faster, more economical production of molded parts.

American Insulator Corp.

NEW FREEDOM PENNSYLVANIA

AICO

SALES OFFICES: BOSTON • BRIDGEPORT • BUFFALO • CHATTANOOGA • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA

Stamp NAMES • DESIGNS TRADEMARKS

in Gold, Silver, Colors on Plastic Products

Precision stampings—positive, clean-cut, enduring—can now be done with ordinary girl operators at production speeds up to 1,000 pieces per hour. Write for catalogue, or submit your stamping problems.

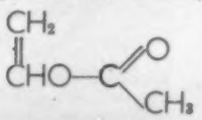
Kingsley GOLD STAMPING MACHINE CO.

★ HOLLYWOOD, CALIFORNIA ★

UNPOLYMERIZED

VINYL ACETATE

(STABILIZED)



Purity 99.5% Boiling Range 71.8° to 78° C.

Vinyl Acetate can be polymerized to form resins with exceptional bonding qualities for wood, glass, metal and fiber. Among the many present uses for these resins are the manufacture of laminated airplane propellers, waterproof finishes for Army raincoats, cable insulation, camouflage paint, airplane coatings, safety glass and water-repellent hospital sheeting.

Containers:—
410 lb. drums; 62,500 lb. tank cars

For further information write to:

NIACET

CHEMICALS CORPORATION

4740 PINE AVE. NIAGARA FALLS, N. Y.

THERE'S NO SECOND PRIZE

in the Battle for Production!

● When the mailed fist of War threatened American production facilities no less than our fighting forces, among the first to accept the challenge was America's youngest industry . . . *Plastics!*

How well you of that industry pitted your knowledge and ingenuity against our common enemies can never be completely told until Johnny comes flying home. And you may be sure that Johnny and hundreds of thousands like him will do the telling. For theirs will be the stories of the remarkable plastic war products you have produced—plastics which not only replaced vital and essential war metals but did the job better. Their recognition of this fact is today already laying the foundation for a greater acceptance of plastics in the scheme of things to come.

If you are one of the manufacturers extending the ways in which Plastics are serving our armed forces, you may have need of the broad, practical plastic finishing knowledge presented by McAleer's *Plastic Finishing Division.*

Write us. We'll be glad to furnish the details and characteristics of McAleer *Quality-Controlled* buffing and polishing compositions. Better yet, send samples of work together with an outline of the finish you desire.

McALEER MANUFACTURING COMPANY
ROCHESTER, MICHIGAN

●

There's No Second Prize in the Battle for Production!

Let's fight and work together! If War needs have put a premium on finishing results, you can reach your production objective with a "tailored-to-fit-the-job" McAleer composition. There is a type best suited to your particular needs.

PHENOL-FORMALDEHYDES • UREA-FORMALDEHYDES • ACRYLATES and METHACRYLATES STYRENES • HARD RUBBERS • CASEINS • ETHYL-CELLULOSES • CELLULOSE ACETATES • CELLULOSE ACETATE BUTYRATES • CELLULOSE NITRATES

McAleer MANUFACTURING CO.
Quality-Controlled Finishing Materials
ROCHESTER, MICH.
PLASTICS FINISHING DIVISION ★ ★ ★

FEEL THAT SMOOTH EDGE?

IT SPELLS *fast* ASSEMBLY

FOR YOUR PRODUCTS

Perhaps no step in the manufacture of molded parts for your product is of greater importance to you than the humble finishing operation. Cleanly finished parts slip into your assemblies with micrometric exactness . . . prevent rejects and slow-downs.

Before a part can pass our rigid final inspection all flash at the mold parting line is accurately buffed off, molded assembly holes must be free from fins, metal inserts are checked for perfect alignment, etc. This careful attention to small but important details shows up favorably in *your* time sheets.

Within the next few months we will have some press capacity open, and welcome your inquiry for compression molded parts or products. Send us your specifications or call on us for engineering assistance . . . yours without charge. MOLDED PRODUCTS COMPANY, 4533 W. Harrison St., Chicago.

PLASTICS DIVISION
MOLDED PRODUCTS

MEYERCORD DECALS

(Acme Photo)

Launching scene of the first PCE boat (Patrol Craft Escort) built on a production line in the Pullman-Standard Car Mfg. Co. shops on the south side of Chicago. The ship was built piece-by-piece in a factory, then assembled and welded at water's edge. Two Hundred Forty Two Meyercord Decals provide interior markings.

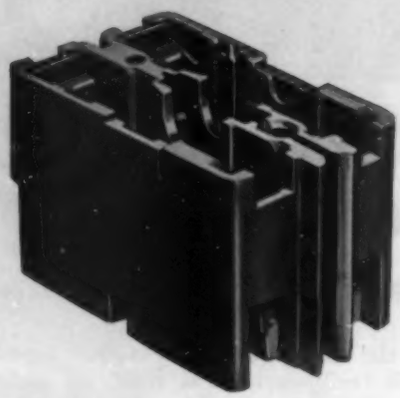
Shipbuilders are speeding the war effort by using durable, quickly applied Meyercord Decals instead of slow, laborious hand stenciling for interior markings on escorts, mine sweepers, merchant vessels, and aircraft carriers. *Hundreds of man-hours* are saved in applying Decals in one simple, quick operation. Decal lettering provides uniformity and greater visibility at lower cost; easier, faster replacement, and simplicity of maintaining reserve supply aboard ship. Whatever *your* identification needs . . . nameplates, trademarks, signs, insignia . . . dial faces, instrument panels, etc., . . . Meyercord Decals will do the job. They're adaptable to any surface, washable, durable, uniform, highly visible and permit use of any color. No sharp edges, screws, bolts or rivets. Consult Meyercord Decal Engineers on your requirements. No obligation. Address Dept. 1107.

Meyercord Decals replace critical metals. Leading manufacturers of America have enjoyed their precision and uniformity for over fifty years. Save time, metal and money with Decals.

Buy WAR BONDS and STAMPS

THE MEYERCORD CO.
5323 W. LAKE ST. • CHICAGO, ILL.

It May Be Little, but OH, MY!



It's the little things in

PLASTIC MOLDING

that count. Notice the detail in the picture above. Jobs like these are an old story to us. After the war the whole story can be told.

Kuhn & Jacob
MOLDING and TOOL CO.
1204 Southard St., Trenton, N. J.
New York Office, PEnn 6-0346

NEW *Adjustable* FLY CUTTER

Holes or Disks 4" to 10"
One Inch Thickness Capacity
Unique Blade Arrangement
Simplified, Long Life Design

This remarkable new Clark Cutter does the work of several tools, results in substantial operating economies. PITCHED BLADES of precision-ground High Speed Steel set with 11-degree drag cut true and smooth . . . relieve chatter; make clean, long-curl chips, give longer bit life. REMOVABLE PILOTS, hardened and ground, permit use of lead drills. Only 1/8 inch work clearance required; allows deeper cuts without undue blade stress. Straight or tapered shanks. PROMPT DELIVERY on suitable priority. *Write for Bulletin No. MP-7.*

Clark Hole Cutters and Surface Facers Slash Tool Costs • Write for Details

Robert H. Clark Company
3424 SUNSET BLVD. • LOS ANGELES 26
MANUFACTURERS: PRECISION TOOLS, PRECISION PARTS

Plastics SCRAP WILL HELP WIN THIS WAR

Plastics are strategic materials—we make it our specialty to conserve them by salvaging all scrap and rejects.

We sell reground molding materials of all kinds and colors to substitute and save virgin molding powder.

We buy scrap and rejects at fair prices and guarantee grinding if desired.

Complete custom service: We regrind, remove all metals, sift and separate, and reclaim contaminated plastics materials.

Cellulose Acetate, Butyrate, Polystyrene, Methyl Methacrylate, Vinyl Resins, etc.

A. BAMBERGER
Plastics Molding Materials
109 SOUTH 5th STREET BROOKLYN, N. Y.
Cable: Chemprod — Telephone: EVergreen 7-3887

Wanted!

WILL PAY CASH-
ANY QUANTITY

{ CELLULOSE ACETATE
POLYSTYRENE
BEETLE
BAKELITE
AND SCRAP

TO MOULDERS: We are prepared to place quantity orders for long and continuous runs of lipstick containers, rouge boxes, etc., to be made from our own moulds.

HARRY BRODER CREATOR AND DISTRIBUTOR OF COSMETIC CONTAINERS
5 EAST 47th STREET, NEW YORK, N. Y. • PL 8-0520

Consider the Facts Please

To the buyer of plastic moldings, the welter of claims and counter-claims among manufacturers might very well be confusing.

In considering our service, therefore, we would like to have you note only a few salient facts:

1) Our 50 years' experience
2) Serving important customers
3) Molds made in our own toolroom
4) Special emphasis on dielectric strengths

Customers tell us they've been relying on "Electrose" for so many years, we've become a habit. We invite your problems.

INSULATION MANUFACTURING CO.
CUSTOM MOLDERS OF PLASTICS FOR INDUSTRY
11 New York Avenue Brooklyn, N.Y.

THROPP MILLS

For Experimental & Laboratory Work....

... are custom built and precisely suited to the requirements of the plastic industry. They embody many new features of outstanding importance. Write for specifications and prices.

Oil Retainer Seals...

...on roll journals prevent oil contaminating stock used on the rolls.

Wm. R. THROPP & Sons Co.
Trenton, N. J.

6,000 lb. per sq. in.

This month we want to emphasize the fact that the device shown at the right actually handles pressures up to and including 6,000 pounds per square inch, and *without shock*. It handles water, oil, or air. It is widely used in plastics plants, but we find that many plastics executives have not yet heard of it. It is sensitive, strong, and dependable. If interested, full particulars will be mailed to you by simply mentioning

ATLAS Type "E"
High Pressure Reducing Valve

It is Superior Because:—

Every detail in the valve is modern in every respect, being based on latest research and design. Forged Steel Body. Internal metal parts entirely of stainless steel. A formed packing of special material superior to leather is used which is immune to all fluids commonly used in hydraulic machinery. The pressure on the seat is balanced by a piston with the result that variations in high initial pressure have little effect on the reduced pressure.

For other ATLAS plastics plant products see the partial list in our ad in the January 1943 issue of MODERN PLASTICS.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
277 South Street, Newark, N. J.
Representatives in Principal Cities

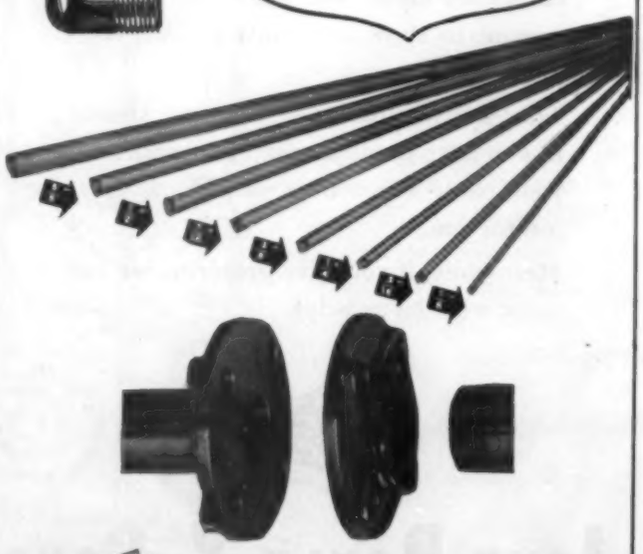
"and Hodgman *Saran solved our problem"

That's what loads of folks and firms are now saying about this remarkable material. Saran by Hodgman is a tough thermoplastic specially made to replace strategic materials such as aluminum, stainless steel, nickel, copper, brass, tin and rubber. It is adaptable for use under high working and bursting pressure and is resistant to most chemicals. Its insulating qualities, flexibility and ease of handling make it extremely valuable in installations requiring the transport of oil, gas, air, water and corrosive chemicals. Flare type fittings for the tubing make it possible to install a complete system with no more tools than a sharp knife and a flaring tool.

In the designing of plastic products, Hodgman Saran Tubing, Pipe and Fittings offer a wide variety of possibilities in construction as well as for the transport of liquids and gases or for insulating electric wires.

It is worth your while to investigate.

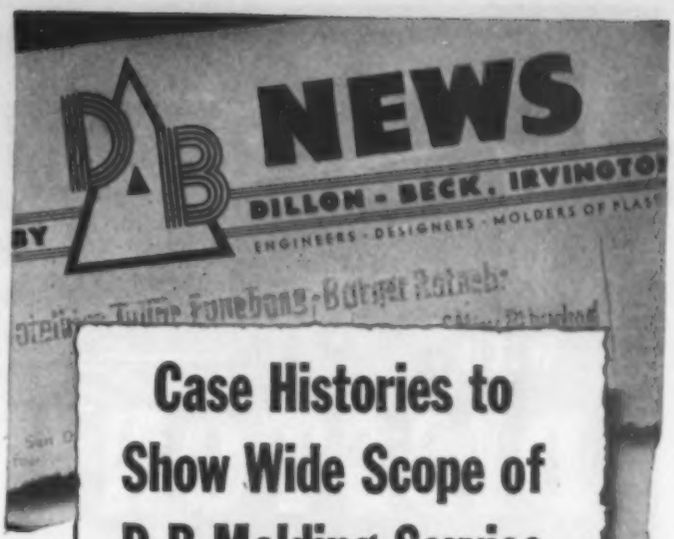
Send FOR DATA SHEET AND FREE SAMPLE.



*Pat. No. 216093

HODGMAN RUBBER CO.
FRAMINGHAM, MASS.

NEW YORK . . . 261 Fifth Avenue
CHICAGO . . . 412 South Wells St.
SAN FRANCISCO . . . 121 Second St.



Case Histories to Show Wide Scope of D-B Molding Service

Outstanding Examples of Dillon-Beck "Know-How" To Appear Every Month In Modern Plastics

IRVINGTON, N. J. — Ingenuity and a comprehensive molding service have combined to speed up production of many items essential to the war effort. This will be the theme of an interesting series of case histories from the files of the Dillon-Beck Manufacturing Co.

"Our business is based on a complete molding service which carries through from original planning to finished article," declared Daniel C. Dillon, Jr., president of the firm. "We feel that the case histories we intend to present are factual evidence of the wide scope of that service and as such, can be considered industrial news-stories of interest and informative value to every user of plastic parts."

Plans call for this series to begin with the August issue of "Modern Plastics", and the first instance will cite a case in which several thousands of dollars in mold costs were saved and an apparently impossible delivery date was met.

Through a recent expansion of facilities, the company's departments now include a completely equipped machine shop for making metal parts and inserts, tool room for making dies and molds, molding department for injection molding to 6 ounces, finishing department, fabrication department, engineering and drafting department, and experimental department capable of turning out 3-dimensional, hand-made samples.

Formerly manufacturers of plastic toys and sporting goods, the Dillon-Beck concern is now engaged entirely in war work.

DILLON-BECK MANUFACTURING COMPANY
IRVINGTON, N. J.

ENGINEERS · DESIGNERS · MOLDERS

Replace
Restricted
Alloy Steels
with

DISSTON PLASTIRON

FOR PLASTIC MOLDS

Disston Plastiron is a non-strategic, non-restricted electric furnace steel, produced by modern tool steel practice by a world-famous toolmaker.

Disston Plastiron has a very low carbon content—is thoroughly clean and uniformly sound—produces exceptionally smooth cavities—will withstand extreme hobbing—carburizes easily—and proves an ideal material for difficult shapes.

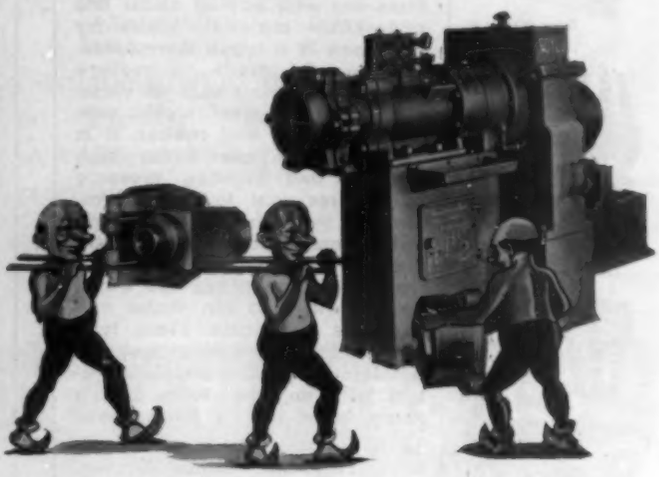
METALLURGICAL AND ENGINEERING AID from Disston specialists is available to help you use Plastiron most effectively. No obligation. Write fully to Henry Disston & Sons, Inc., 734 Tacony, Philadelphia 35, Pa., U. S. A.

DISSTON PLASTIRON

ESTABLISHED 1840 REG. U.S. PAT. OFF.

The non-strategic steel for molds.

KEEP EXTRUDERS *in the* FIGHT!



Heads Up!!

Because Royle plastics extruding machines are all on war work, we must be content to show here only a "still life" photograph.

After the war has been won, we should like to have Royle extruding machines in your plant where they will do a great job for you.

Meanwhile, if you have problems we can assist with, let us help.

ARMY E NAVY

JOHN ROYLE & SONS

PATERSON 3, N. J.

AKRON
J. C. CLINEFELTER

LONDON
JAMES DAY (MACHINERY) LTD.

DIFFICULT?
SURE, BUT NOT WHEN YOU KNOW HOW...

In "knowing how" lies the secret of success in all fields of endeavor — in plastics too.

CHURCH has had extensive experience — knows how to approach plastic problems for a practical solution.

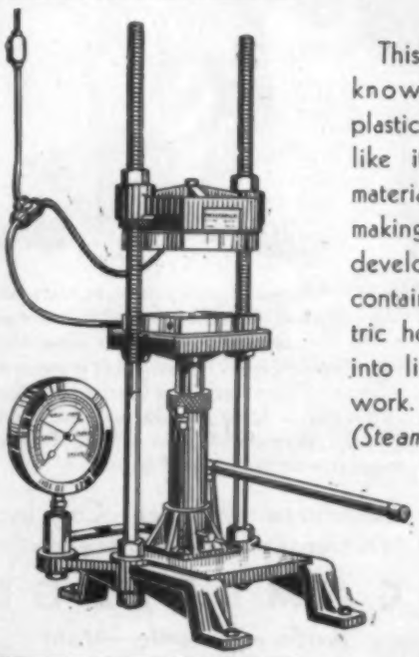
Injection
Compression
Plastic Molding

CFC

C. F. CHURCH MFG. CO. • HOLYOKE, MASS.

Division of AMERICAN Radiator & "Standard" Sanitary Corporation

The CARVER LABORATORY PRESS *for Plastics Research*



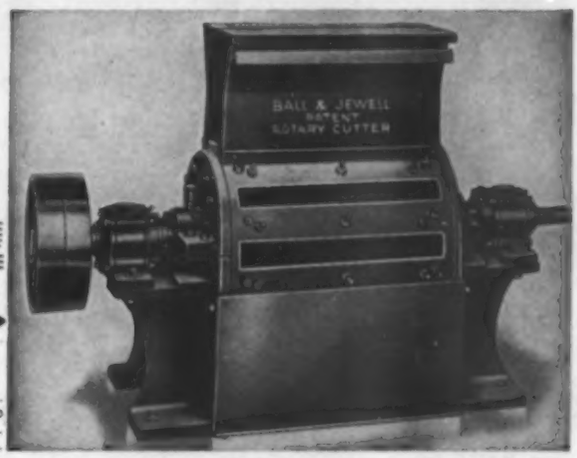
This little press is well known throughout the plastics industry. Nothing like it for testing plastic materials, single cavity molds, making samples, research and development work. Self-contained, fitted with electric hot plates — just plug into light socket and go to work.

(Steam hot plates if desired.)

Write for Catalog.

FRED S. CARVER
HYDRAULIC EQUIPMENT
343 Hudson St. New York

Save Manpower, Materials, Time
GRIND & RE-USE PLASTICS SCRAP



Model #1. Capacity to 1000 lbs. per hour.

The grinding and re-use of plastics scrap has always been economical. Now it is being urged by WPB to utilize all available materials, save manpower and manufacturing facilities, speed up plastic molding and extruding.

Ball & Jewell scrap grinders are helping molders, extruders and others all over the country conserve materials. There's a size for every plant. Each with motor or belt drive, as preferred. Independently sealed outboard SKF bearings, proof against plastic dust. Solid tool steel knives. Three interchangeable screens for different-sized granulations.

Write for FREE catalog of 13 models.

BALL & JEWELL
20 Franklin Street **Brooklyn, N. Y.**
Since 1895, Manufacturers of Patent Rotary Cutters

NEW YORK: Alsing Engineering Co., 111 Eighth Ave. DETROIT: J. C. Austerberry's Sons. CHICAGO: Neff, Kohlbusch & Bissell. NEW ENGLAND: Standard Tool Co., Leominster, Mass. ST. LOUIS: Larrimore Sales Co. LOS ANGELES & SAN FRANCISCO: Machinery Sales Co. LOS ANGELES: Moore Machinery Co. LONDON, ENGLAND: Blackfriar's Engineering Co., Ltd. CANADIAN AGENT: Williams & Wilson, Ltd., Toronto & Montreal, Canada

RAYCO FLOCK

ROUND the CLOCK

•

Every hour of the day Rayco fillers are being used in plastics by concerns producing for the war effort.

•

COTTON FLOCK FABRIC FILLER

SPECIAL TYPES

•

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PLASTICS MOLDING

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INJECTION MOLDING

A SPECIALTY

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Ask us for QUOTATIONS on your requirements. No obligation.

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The S. S. White Dental Mfg. Co.

INDUSTRIAL DIVISION

PLASTICS DEPARTMENT M

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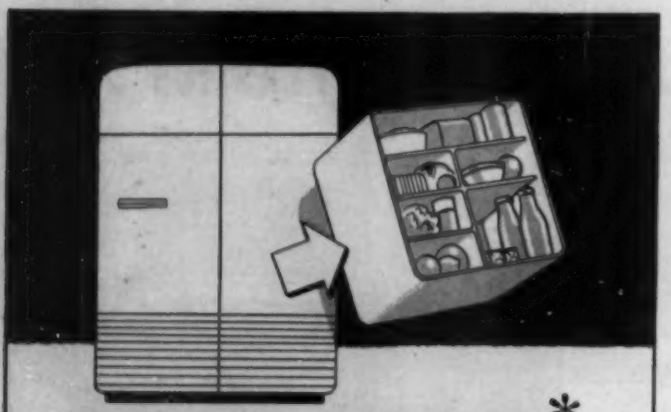

NEW PRODUCTS*

The interior of your post war refrigerator may be molded as a single plastic housing—easier to clean, permanent in color and finish.

Will your 1942 product stand up in post war competition? New Plastics and molding techniques have advanced tremendously since your product was designed. Consumer savings will be higher than ever before in history—inventories lower. Can you afford to gamble a 1942 product on such a market?

We are well staffed for creative designing and product development in plastics. Let us apply our war time skills to your future product.

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PRODUCTS INCORPORATED

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* For post war products —think of Bridgeport.

Today—the Plastic Molder not only works with substitute materials, but in many cases he is doing new kinds of work as well. He therefore needs a dependable Pyrometer more than ever to check mold temperatures in order to follow new formulae. The Cambridge Mold Pyrometer is ideal for his purpose. It is accurate, rugged and quick-acting. Powder manufacturers recommend its use.

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PYROMETERS

Bulletin 194–S gives details of these instruments. They help save money and make better plastics.

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PLASTICS SCRAP in proper hands will make essential articles for the home front. Consult...

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CHICAGO: 327 So. La Salle St. · AKRON: 250 Jewett St. · LOS ANGELES: 318 W. 9th St. · MEMPHIS: 46 W. Virginia Ave. · BOSTON: 31 St. James Ave.

No Metal?.. *Use Plastics!*

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MAY HAVE THE ANSWER TO *YOUR* BOTTLENECK!

Molded plastic parts of the most intricate kind were going strong long before anyone started worrying about "critical metals"... Stokes' designers and production men were thinking, researching, planning, *manufacturing*, long before a gun was ever fired. And Stokes' staff is ready now to help you meet the war need—quickly, efficiently, economically.

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PLASTICS FOR WAR

PLASTICS FOR PEACE

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CUSTOM MOLDERS—ALL FORMS OF HARD RUBBER AND PLASTICS

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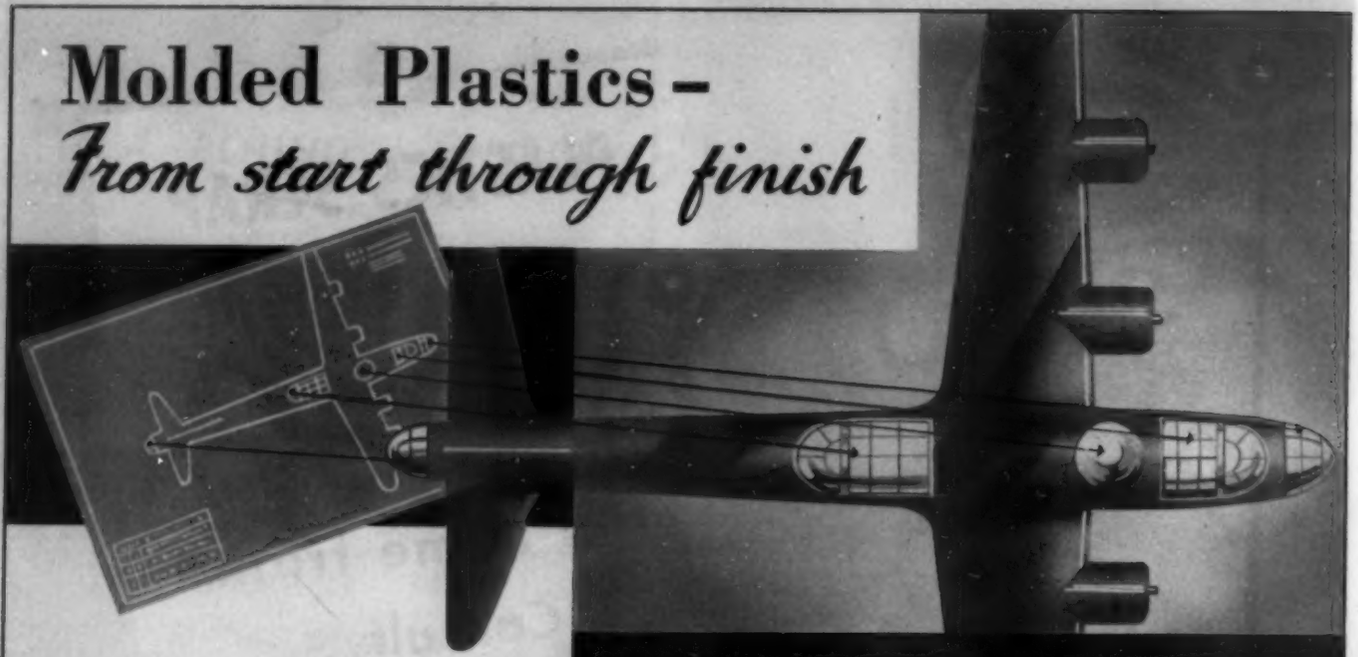
Molded Plastics –
From start through finish



Plastics . . . by Reynolds . . . includes all skilled organization processes from original design, or redesign, straight into production molds and molding, all through satisfied customer delivery. Here is a complete service that will solve your plastic problems.

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Reynolds Molded Plastics

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SALES ENGINEERS IN ALL PRINCIPAL CITIES

DIVISION OF REYNOLDS SPRING COMPANY
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Precision Molds Broaden the Field for Plastics

Crystal cases of Signal Corps field radios; relay boxes for PT-boat ignitions; screw-parts for weight-saving assemblies — intricate shapes quickly molded of plastic instead of painfully machined from metal — these are a few of the economies in critical materials and time which have been made possible because of Precision Molds.

Almost daily, inquiries come to us from troubled manufacturers asking whether plastics could be molded accurately to meet specifications. To those who send sample items, or who furnish details, we reply almost daily that a comparable job is being done now!

Why not let us co-operate in the solution of your problems as they relate to time, costs, materials and specifications?

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Peace-time engineers of soft-rubber connectors for electrically-operated equipment

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BRANDING on *Plastics* is the order of the day!

★ War time demands for the swift, accurate production of plastic parts have made Rogan's *deep-relief* branding method the order of the day.

Many essential plastic war parts, of every conceivable size and shape, are now being marked to specifications by Rogan's exclusive method of branding in *deep-relief*. Accurate graduations, lettering, designs and other markings are fused into the material for permanence. Note Rogan branding on curved surfaces of Bakelite housing illustrated at right.

We urge you . . . write for complete details on this faster, less costly, *approved* method for marking plastics . . . Rogan *deep-relief* branding.

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INJECTION AND COMPRESSION MOLDING

Some don't put all their eggs in one basket!

It is beginning to be realized more and more that maximum production is possible only when prime contracts are generously sub-contracted, and all permissible substitutions of materials are promptly and wisely made. Instead of putting all their production "eggs" in their own basket, and courting bottle necks, an increasing number of executives are turning to "Waterbury Plastics".

If unfamiliar with plastics as exemplified today in "Waterbury", you will be interested in the strides this medium has made. Heat and wear resistance, tensile strength, elasticity, and color now approach close to perfection. And the technique of including in the molding process, struts, bosses, holes and channels, as well as the setting of metal inserts, leaves little if any machining and fitting to be done. If you do know your plastics, then we need only to emphasize that "Waterbury Plastics" dates from the very beginning of the industry!

"Waterbury Plastics" includes one or all of these services: Designing, Engineering, Mold Making, Molding, Assembling. Let's get better acquainted. Send us a contract for estimate.

Waterbury Plastics

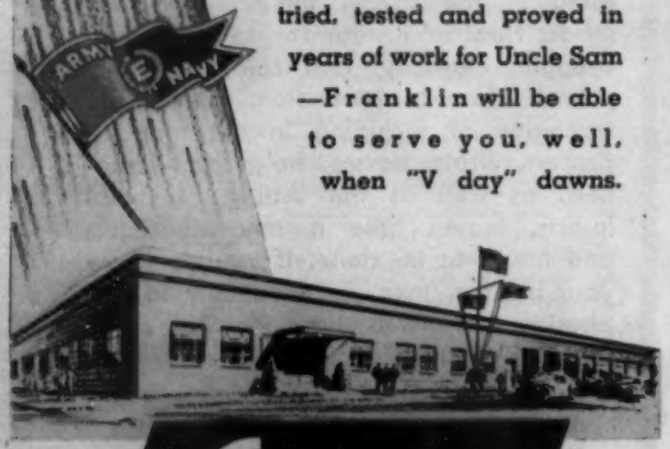
THE WATERBURY BUTTON CO.
WATERBURY, CONN., U. S. A.

WBC

EST. 1812

* Post War Plastics

Plastics have been assigned a leading role in the post-war era by every writer who discusses things to come. It is certain that many improvements made in present products and many of the new items promised for the post-war era will use plastic molded parts in their production. If you have a post-war product in contemplation for the days after victory — get in touch with Franklin. With facilities for the making of injection molded plastic parts of the most modern kind and an organization, tried, tested and proved in years of work for Uncle Sam —Franklin will be able to serve you, well, when "V day" dawns.



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INJECTION MOLDING ★ EXTRUSION MOLDING ★ MECHANICAL PRESS MOLDING ★ FORMING ★ ASSEMBLING

PRIME contractors, sub-contractors, custom and private molders . . . we offer you the most modern plastic processes, a complete designing service and, if required, finishing and assembling. We process thermo-plastics of all types by injection, extrusion or forming methods . . . also fabricating of laminated phenolic materials . . . etc. Volume business and efficiency enable us to meet strict price limitations. Let us submit an estimate on your next war order.

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CLAREMONT COTTON FLOCK FILLER

It's an actual fact—cotton flock filled plastics are the strongest in impact and tensile strengths.

And it's also true that CLAREMONT cotton flocks are stronger than inferior grades. Their longer fibres, cleaner and more uniform composition, when combined with resins, make better plastics.

Probably the best proof is that the plastics industry has used more than 25,000,000 pounds of CLAREMONT flocks.

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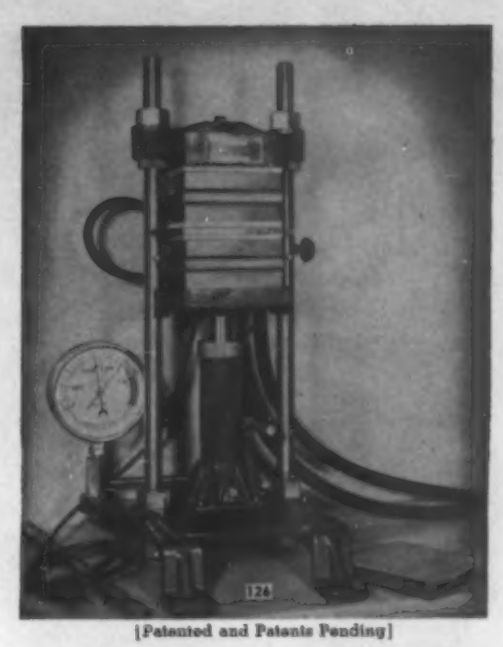
PRODUCES TAMPERPROOF IDENTIFICATION CARDS *and* BADGES IN YOUR PLANT

• Government departments and war industries are adopting, in increasing numbers, the new tamperproof laminated identification badges and cards. Each is sealed permanently between two thermoplastic sheets, cannot be removed without destroying cards.

The Carver Laminating Press comes in three models: No. 122 turns out 150–200 cards per 8-hour day; no. 124 laminates 300–400 cards; no. 126 produces 600–800 cards. Each will handle approximately twice as many badges.

Each press is fitted to operate directly from 110 volt A.C. lighting socket (D.C. supplied at slight extra charge). Prompt deliveries—priorities required under WPB order L-159.

Send for Folder and Prices. We do not supply printed cards, badges or plastic materials.



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Our Southern mills have made high tensile cotton fabrics for the Plastics industry for fifteen years and specialty industrial cotton textiles for over thirty-five years. Our experienced development and production facilities are available to the Plastics trade, limited only by the requirements of our armed forces.

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Our Job . . . Today
is to help
WIN THIS WAR

100% Production for Our Armed Forces

We know we are doing our job—and doing it well. Every single Michigan Molded employee is giving the best he's got. Each knows that less than 100% effort is not enough.

However, our few relaxing moments are devoted to future markets and the many entirely new products we will be making in another all-out effort to help maintain the peace.

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100% PLANNING FOR FUTURE MARKETS

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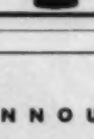
Conservation of vital materials calls for efficient **Scrap Grinders**—Ball & Jewell New England Representatives.

Plastic Material Dryer—Parks Standard—U. S. Agents. An efficient Dryer of all materials, scientifically developed for this purpose alone.



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Shapes — Profiles
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Material Handling and Processing Equipment
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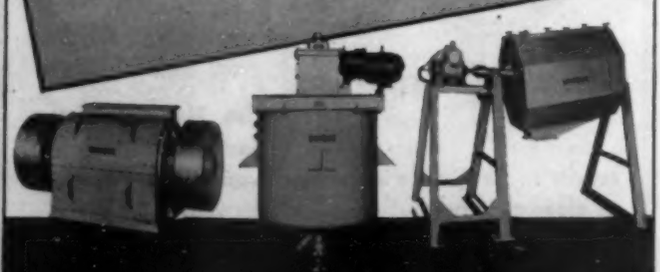

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the Combined Engineering and Manufacturing Facilities
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We're Molding Masterpieces...

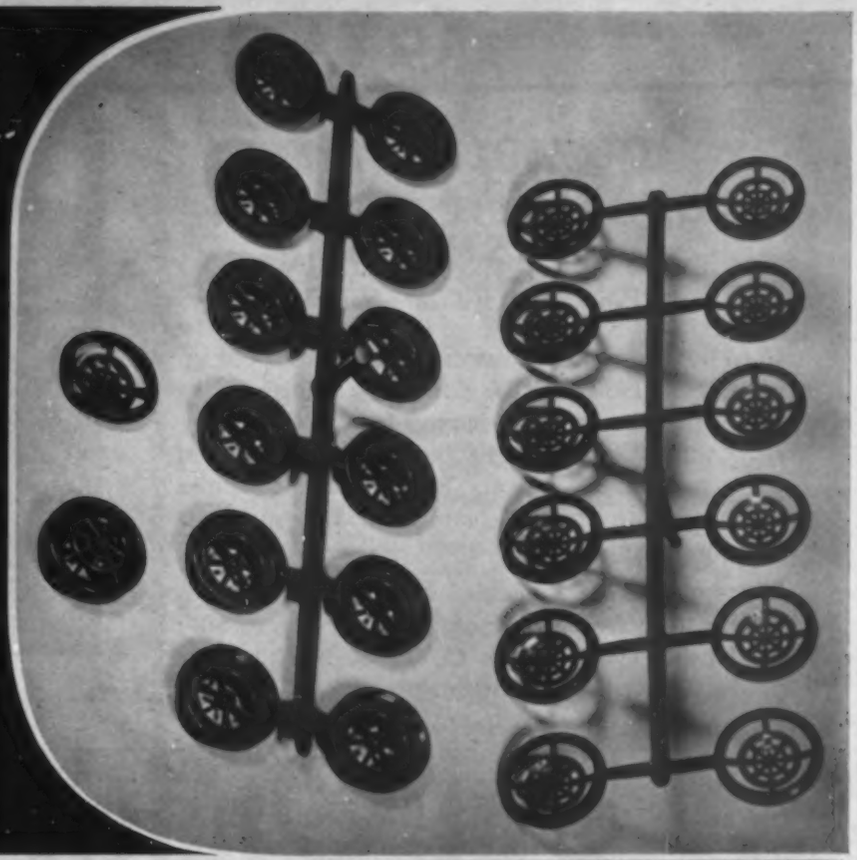
BUT WE CAN'T MOLD ANY FOR YOU—

—not yet . . .

OUR BIG JOB . . . our *only* job right now is to keep feeding vital supplies to the armed forces . . . and what we are doing is mighty important. BUT . . . we know our boys will be coming home one of these days . . . so we're planning — and preparing for *that* day . . . and *you* should, too!

Our expert "technical brains" (and we have quite a staff) are available *today* for consultation on your post war plastic plans. Might be a good idea to have a chat with them.

Ideal — A SYMBOL OF FINEST CRAFTSMANSHIP IN PLASTICS



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WHEREVER FLEXIBILITY IS REQUIRED

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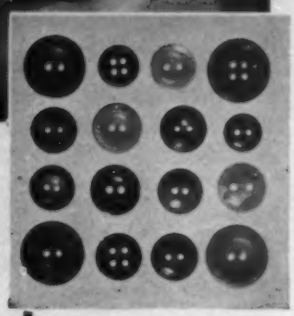
COMPLETELY AUTOMATIC BUTTON FINISHING

Punches Fins — Cleans Holes

Used by leading button manufacturers to speed up production, BUTTONDEX machine reduces finishing costs so greatly that it pays for itself in a very short time. Compact design enables manufacturers to save factory space. Each machine comes equipped with one dial plate, drilled to specifications and set to run.

These models are available: Model *S* accepts sizes 12/ to 34/; Model *SP* accepts sizes 36/ to 50/; Model *SX* accepts sizes 12/ to 50/. They give production up to 450 buttons per minute.



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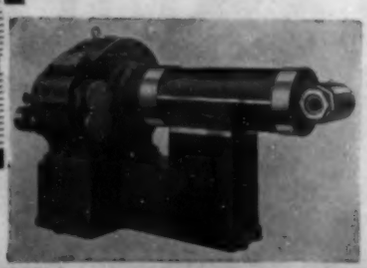
Continuous Extruding of Plastics for Wire Insulation and Trim

SEND for a copy of this bulletin that will tell you about a new line of Extruders that has been developed from our well known rubber extruding work. Every machine we build today must contribute directly to the winning of the war—however, you will want to have this bulletin on file whether your need is urgent or not. Write for a copy.

National Erie builds a complete line of Extruders, Presses, Mixing Mills, Special Doors for Pressure Vessels, etc., for rubber and plastics.



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ERIE, PA. U. S. A.

VICTORY WILL BE OURS

BY PULLING TOGETHER!

We are here to serve our Country, and Customers Old and New, by Providing High Quality Molded Parts.

Our trademark stands for justice, and is backed by an engineering staff of more than thirty years experience.

This background is yours for the asking. Consult us with your problems, small or large, simple or complicated.

Compression and Transfer Molding of Thermosetting Materials Is Our Specialty

PLASTIMOLD, INC.
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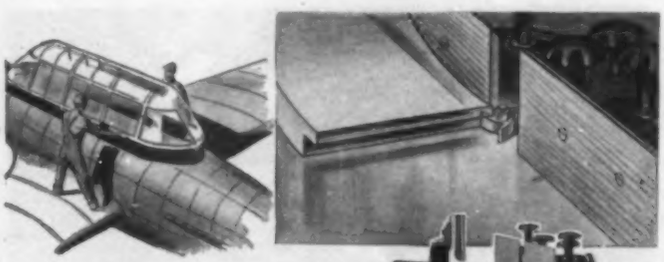

Rabbeting Plexiglass Panels for Smooth fit in Metal Frames ..a job for the CARTER S5A Table Shaper

For perfect streamlining, transparent plastic panels must set in metal frames with a smooth flush fit. The necessary rabbet around the edge is cut fast, clean, and to accurate dimensions on the Carter S5A Table Shaper. Most shapes and contours can be handled with simple jigs.

The 1 H.P. motor unit on the Carter S5A can be tilted 45° backward, 25° forward to permit all types of cuts. Write for details. R. L. Carter Div., The Stanley Works, 175 Elm Street, New Britain, Connecticut.

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POSTWAR PROBLEMS

A world-famous machine tool builder with good management, high-caliber sales organization, field engineers and service men, skilled labor, modern machines, new plants, and adequate capital is

WIDE OPEN FOR POSTWAR MANUFACTURING IDEAS

FOR 63 years, since 1880, we have built *exclusively* turret lathes and high precision small tools used on turret lathes. These products have won us a world-wide reputation as leaders in the machine tool field.

The turret lathe is a key tool for war production. To serve our country and its allies, we went all out for war, increasing manpower, plant space and equipment. Our output rose to many times that of normal needs. We have far more productive potential than we need if we return to normal operations after victory. But we would prefer to utilize the assets we have built up in machines and men—and women.

Therefore, a postwar planning committee has been set up and given authority to consider *anything* and *everything* which can use our manufacturing and marketing facilities. We are interested in ideas for *improved* machinery, or *new* machines for industry, business, homes, farms, or transportation. Perhaps we can build and market the complete machine or you may want us only to build parts and units because we may do it better or at lower cost. Maybe it isn't a machine —it may be a device or instrument for science or entertainment that requires precision parts.

Any idea or proposal brought to us will be given the protection and courteous and confidential consideration which you have a right to expect from a reputable company. We suggest that you first give us as much information as you can in a letter. Our reply will tell you if it appears to our mutual interest to arrange a meeting—if not, we will tell you why not and perhaps suggest some alternative action. Address Postwar Planning Committee—

THE WARNER & SWASEY CO.
Cleveland, Ohio

giving wings to caps and closures—

"brings Victory still closer!"

Here we have a paradox; planes and closures on common ground.

Yet there is a close relationship. . . .

Back in the heyday of happiness and good fellowship, MACK MOLDING facilities produced—among numerous other products—caps and closures for bottles, jars, tubes, etc., for the food and drug industries.

Following the rapid succession of alarming events which introduced us to World War II the complete facilities of the three MACK plants are now producing components for the essential tools of war.

We are thinking post-war again; we hope you are, too. If you have ideas or plans which will fit into our peace-time capabilities, please address your inquiries to MACK MOLDING COMPANY, 100 Main Street, Wayne, New Jersey.

Mack MOLDED EXCELLENCE

SALES OFFICES: NEW YORK CITY, CHICAGO, DETROIT, INDIANAPOLIS, BOSTON & ST. LOUIS

READY TO TALK POSTWAR?

LARGE nationally known distributor of home furnishing items desires to contact manufacturers in the plastic, steel or wood fields to exchange ideas on civilian postwar items with a view to further expansion and acquiring additional important sources of supply.

OUR company is long established and highly rated and enjoys an enviable reputation and acceptance with the leading chain, mail-order, department and furniture stores in the United States.

All replies will be held strictly confidential.
Box 810, Modern Plastics

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PLASTICS

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RUBBER MOLDING BAGS
for
PLYWOOD AND VENEER PRESSING

• Bags made of Rubberized Fabric or All-Rubber for cold or hot processes. Where heat is required we have developed unusually effective heat-resisting compounds to insure maximum number of cooks.

Made to order in practically all sizes from 1 ft. to 25 ft. long in varying widths, with and without tubes.

WRITE FOR INFORMATION AND QUOTATIONS
We are interested in helping you with any special problem

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ANDOVER, MASS., U.S.A.
Manufacturers of Fine Rubber Goods Since 1856

WE build molds for all plastics

More than 20 years of successful experience as toolmaker to leading custom and proprietary molders qualify us as your mold designer and mold maker on your most exacting jobs of plastics engineering.

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MANUFACTURING COMPANY
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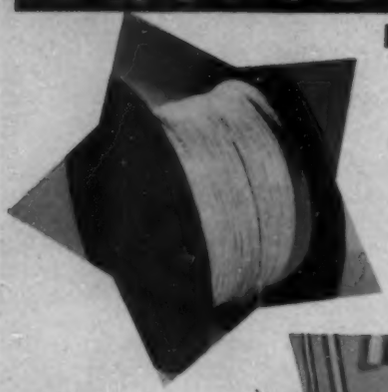

PLASTIC PRODUCTS

ARE BEING WIDELY USED IN CONNECTION *with*
COMMUNICATIONS
RAILROADS
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SARAN—
- MONOFILAMENT
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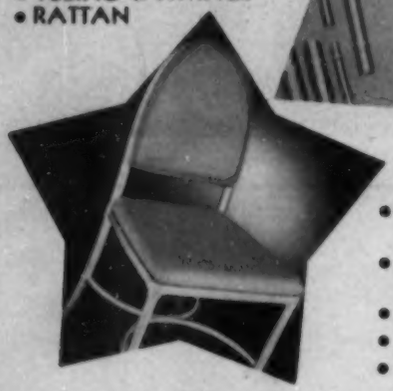
- RATTAN



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- LIGHT IN WEIGHT
- STRONG
- DURABLE

Plastics That Fit The Job

We Especially Invite

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INQUIRIES FROM MANUFACTURERS OF TEXTILES, FILTERS, UPHOLSTERING MATERIAL, ETC.

EXTRUDERS

OF ALL TYPES OF
THERMOPLASTIC MATERIAL

NATIONAL PLASTIC PRODUCTS Company

ODENTON, MARYLAND

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WE HAVE THE ORGANIZATION
IF YOU HAVE THE GOODS

Australian company, very active in the plastics industry, desires to co-operate with a progressive American manufacturer of thermoplastics on a sole distribution basis. While current defense programs and present restrictions on importations into Australia present some difficulties, plan now for peacetime and build up that foundation for the future. Particularly interested in acetates, ethyl cellulose, styrenes, etc. Also the Thermosetting Melamines and Ureas.

Apply **"AUSTRALIA CALLING"**
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MODERN PASTICS
122 East 42nd St. New York

GENERAL PLANT SUPERINTENDENT

ONE of the oldest manufacturers in the Philadelphia district needs a general plant superintendent.

Our products are small, interchangeable, precision parts of metal and plastic. Ordinarily one of the most widely distributed lines in the world, our time and talent are now largely devoted to the war effort.

The man we are looking for will know the joy of working with skilled and loyal subordinates, understanding and cooperative associates. He will be the one to whom 600 workers will look for enthusiastic, resourceful leadership. He will know how to make the most of men and machines—take pride in the maintenance of high quality standards and assume responsibility gracefully.

Such a man should be between 40 and 45 with a background that predicts success in the position we now have available.

If you are interested, our company is large enough to offer an attractive financial future and small enough to preserve your personality. The starting salary is open. Your letter of application should include your qualifications, references, and expected starting salary. If you are employed in a war industry, please do not apply.

REPLY BOX 809, MODERN PLASTICS

All classified advertising payable in advance of publication. Minimum, $5.00 (up to 60 words); in border, $10.00 per inch.

Classified Advertisements

For further information address Classified Advertising Dept. MODERN PLASTICS 122 East 42nd St., New York, N. Y.

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WANTED: Specialties in Plastics for Aircraft or other War Industries by well-established Canadian firm now acting as Prime and Sub-Contractors for vital defense work. To sell outright or on Commission, on exclusive basis for Canada. Reply Box 759, Modern Plastics.

CHIEF ENGINEER wanted by a large Pennsylvania custom injection plastic molder. Must have successful record in injection plastic mold designing, molding technique, and related qualifications. Production and development projects included in duties. General engineering knowledge required. Highest salary for right man. Our men know of this advertisement. All replies will be treated confidentially. Reply Box 757, Modern Plastics.

WANTED: Experienced molder of plastics for the development of molding equipment and the molding of asphaltic products. This work in development stage: company owns patent on molded asphaltic products. One of largest independent petroleum refiners in Midwest. Reply Box 764, Modern Plastics.

ESTABLISHED NEW YORK INDUSTRIAL DESIGNER offers exceptional immediate and postwar opportunity for young imaginative experienced Industrial Designer. Send full details, education and experience. Reply Box 812, Modern Plastics.

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WANTED: Hydraulic Presses, Preform Machine and Mixer. Stainless Steel or Nickel Kettles, Vacuum Pan. No dealers. Reply Box 275, Modern Plastics.

FOR SALE: 1—W.S. 15" x 18" Hydraulic Press, 10" dia. ram; 2—D. & B. 20½" x 20½" platens; 1—14" x 24" Press, 9" ram; 9—24" x 55" Steel Cored Heating Platens; 1—Farrel Birmingham 15" x 36" Rubber Mill; 4—W. P. Mixers; 1—Set of Compound Rolls 15" x 36"; Adamson 6" Tuber; Dry Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 446, Modern Plastics.

WANTED: Small or medium sized plastic molding plant with either hydraulic extrusion or injection equipment with or without tool shop. Advise full details. Reply Box 788, Modern Plastics.

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin materials. Submit samples and details of quantities, grades and color for our quotations. Reply Box 508, Modern Plastics.

FOR SALE: Motor Driven Air Compressor, Size 12 x 10, 260 cu. ft. displacement, 100 lbs. pressure. Reply Box 512, Modern Plastics.

WANTED: Engineer thoroughly acquainted with the manufacturing methods, design of equipment and design of molds in plastics injection work. This is an excellent opportunity for advancement with a new injection development in a large corporation. War work and after the war. Only those eligible under WMPCES plan need apply. State training, experience, personal details and salary expected.

U. S. Rubber Co., Detroit, Mich.

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MOLDING SCRAP WANTED: Manufacturer will buy Cellulose Acetate scrap suitable for molding. Samuel Eppy & Co., 333 Hudson Street, New York City.

WANTED

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WANT TO BUY MOLDS suitable for manufacturing non-essential items; toys, flashlights, electrical, household. Reply Box 800, Modern Plastics.

WANTED BY MIDWESTERN CORPORATION

To purchase one or more firms doing injection or compression molding or extrusion of thermoplastics. Primary interest is to have an organization ready for post-war plastics production. Replies will be welcome from large or small companies in any location and will be held strictly confidential.

Reply Box 804, Modern Plastics

(Continued on next page)

MOLDED PRODUCTS from non-strategic Lignin Molding Powder. Have Presses available. Purchaser may have to supply molds or priority sufficiently high to have them made. Reply Box 807, Modern Plastics.

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FOR SALE: Catalin castings for Ladies bracelets and belt buckle slides, practically all colors. Also large round rods. Immediate delivery, price F.O.B. our factory, no Customs duty required. Price 60c per pound or reduced prices to clear. Carl Austin & Co., Ltd., Weston, Ont., Canada.

WANTED: Thermoplastic scrap in any form, including cellulose acetate, styrene, butyrate, vinyl resin, etc. Submit samples; advise quantities and grades. Reply Box 791, Modern Plastics.

WANTED: Vulcanized Fibre Scrap, 15" x 15" or over, .030 to .035 Thickness. Humes and Berg Mfg. Co., Inc., 121 E. 69th St., Chicago, Ill.

WANTED: Chemical engineer or chemist for field contact work and product control—essential war work. Must have experience in thermosetting powders, and if possible, experience on cotton fillers used in compounding. Give full details of age, draft status and experience. Location—R. I. Reply Box 781, Modern Plastics.

WANT ORDERS for products to be molded from Lignin Molding Powder of our own manufacture. War or Non-essential items. Reply Box 808, Modern Plastics.

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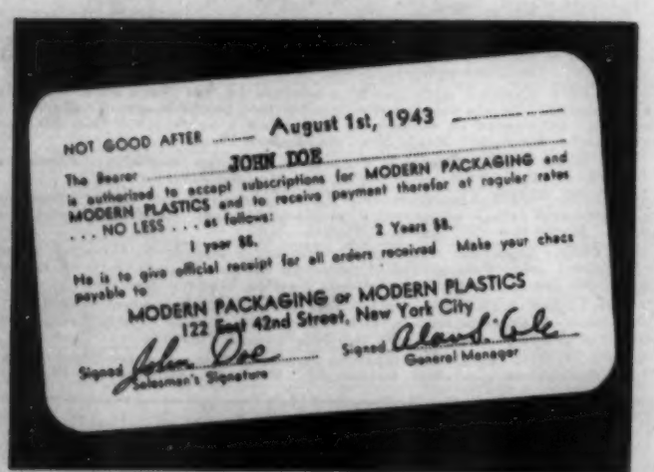
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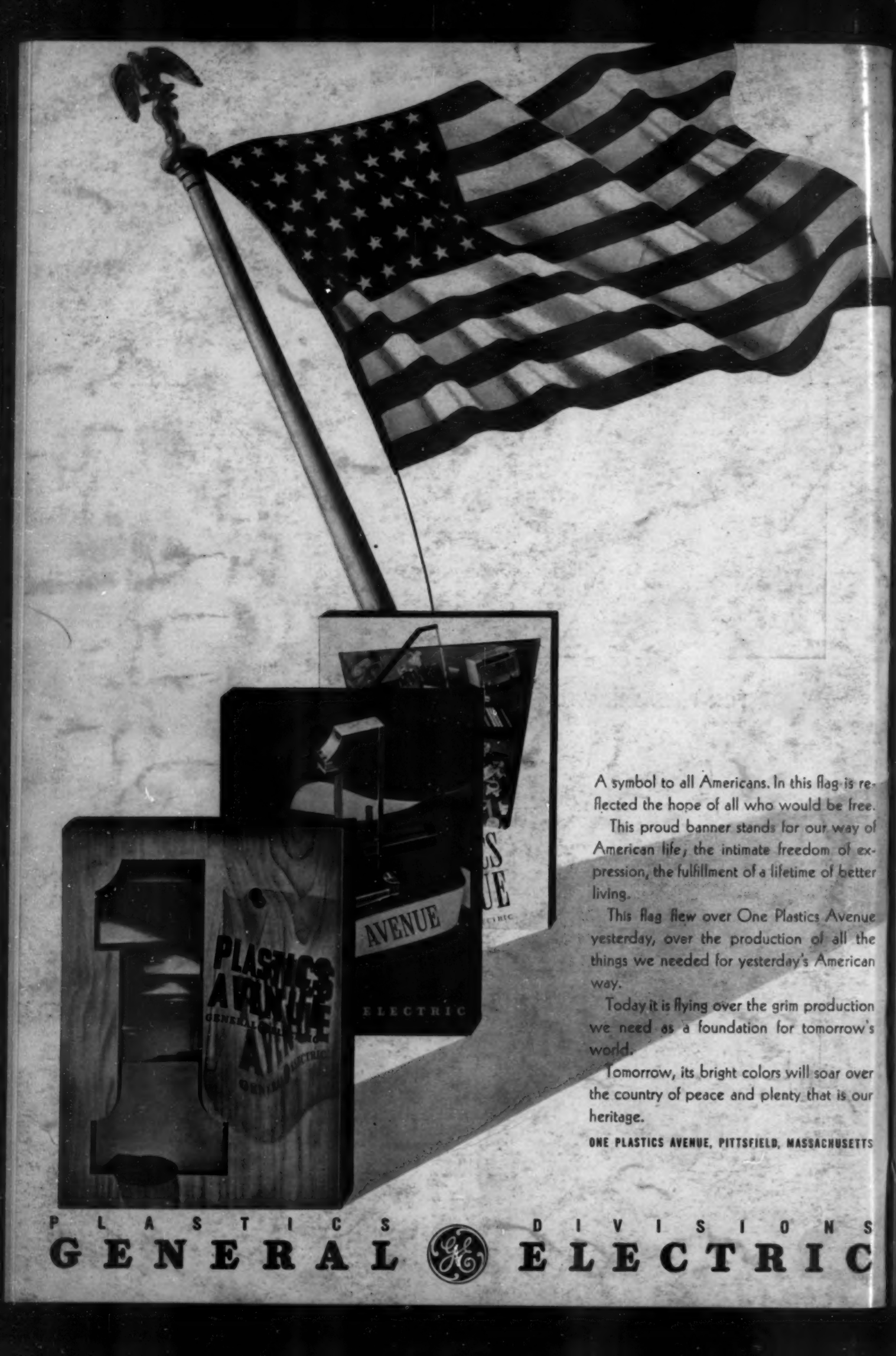

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